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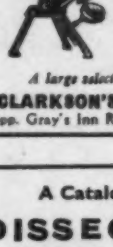

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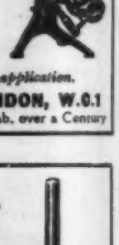

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Population Problems in Relation to Refugees

WHETHER as indicated by the support accorded to the work of the Society for the Protection of Science and Learning, or by the care taken of individual refugees in particular universities, and the efforts made to find opportunities for men of learning to continue their teaching and investigations, the universities of Great Britain have nobly accepted their responsibilities and shouldered burdens which have often involved individuals in real sacrifice. By the universities at least this practical task of caring for refugee men of science and learning has been recognized as an inseparable part of the task of preserving for mankind its full privileges of freedom of thought and investigation. Nevertheless, Sir John Hope Simpson can conclude in his study of the refugee problem* that Great Britain's record in the admission of refugees is not distinguished when compared with that of France, Czechoslovakia or the United States of America.

Even in academic circles, however, the problem has rarely been considered on wider grounds than those of humanitarianism and the defence of freedom of thought and learning. For this reason alone the admirable dispassionate survey of the refugee problem as a whole which has been conducted under the auspices of the Royal Institute of International Affairs is welcome. This carefully prepared and lengthy report gives an exhaustive study of the origins and course of refugee movements as well as a record of the methods adopted internationally and by individual Governments, and of the immense efforts made by the great philanthropic organizations.

The scope of the survey is restricted to post-War movements which originated in European countries, in the Ottoman Empire and in the Russian Empire, and refugee movements arising from natural causes such as earthquake or flood are also excluded. For all these limitations, the survey gives us the essential background for assessing the significance of the refugee problem and the many factors which are involved in it, as well as the various solutions proposed and the obstacles to such solutions and to the movement or absorption of refugees.

One of the great merits of this survey is the way in which the problem is presented in its true perspective. Indeed it might be true to say that the absence of a sense of perspective has been one of the main factors in creating the refugee problem. The American quota system, the British immigration laws and the virtual closing to immigration of the British Dominions have been the chief factors which issued in the refugee problem. Sir John Simpson makes it abundantly plain how the stopping of these safety valves has led to population pressures which have profoundly influenced the course of post-War history. Markets have ceased to expand, and labour in the more privileged countries is anxious to defend its standards of living against cheap immigrant competition. The spread of State control over every aspect of life in itself tends to render nationalism more readily inflamed.

The refugee problem accordingly cannot be detached from population and migration questions generally. However strongly we may reprobate the immediate political causes of a particular refugee movement, or however justly the conduct or policy of a particular ruler or nation is to be

*The Refugee Problem: Report of a Survey. By Sir John Hope Simpson. (Issued under the auspices of the Royal Institute of International Affairs.) Pp. xv+637. (London, New York and Toronto: Oxford University Press, 1939.) 25s. net.

condemned, such causes rarely stand entirely alone. The disappearance of the right of asylum and of *laissez faire* liberalism from the policy of Great Britain even ten years before the Great War are contributory factors which should make us defer hasty judgment.

There are, moreover, various points upon which further *ad hoc* scientific inquiry is desirable. Information as to the economic effect of refugee immigration is not entirely adequate. Inquiries in Holland and Belgium suggest that in these countries the advent of refugees has resulted in the employment of nationals in numbers greater than the refugee influx. In Great Britain the fur trade appears to have gained by the transfer of Jewish business from Leipzig to London, and it has been stated by the Home Secretary in the House of Commons that as a result of the settlement of eleven thousand refugees in Great Britain, employment has been given to about fifteen thousand British workers who would not otherwise have been employed. Sir John Hope Simpson says that the number of British workers employed as a result of German immigration is at least twice the number of refugees themselves.

Numerous cases are known in which new manufacturing businesses have been initiated by immigrants, but there are many other influences at work and the contributions made by refugee scholars and men of science are difficult to assess. The question would justify a full investigation. Already there is evidence to show that the presumption that the admission of immigrants is likely as a rule to increase unemployment is by no means so well-founded as may at first sight appear. The element of consumption has to be taken into account. It is indeed impossible to determine whether the admission of immigrants is more likely in general to increase or to diminish unemployment. The answer depends partly upon the particular industrial aptitude of the immigrants and partly on the economic circumstances prevailing at the time in the country they enter.

The question has accordingly to be considered, not on hard and fast rules, but in relation to the general employment and population trends in the country admitting the refugees. When reasonably active conditions of trade prevail, unemployment may be reduced by a freer admission of immigrants if these are likely to be suitable for the occupations where the supply of labour is relatively scarce. Such a principle must, however, be applied in a generous and not in a narrow-minded spirit. Fairly considerable unemployment figures in a particular occupation can easily co-exist with a genuine shortage of labour, partly because of the small margin of workers of low industrial aptitude always to be found, partly because distinct types of work are often included under the same occupational designation, partly because of regional differences or seasonal and other temporary fluctuations. In many countries, even during the recent recession of trade, shortage of labour in certain industries connected with the production of armaments has persisted. A readier admission of immigrants who would have met the needs of these industries even during this period might have been economically advantageous, apart from its beneficial effect on defence preparations.

From this point of view, decisions taken under the influence of an unsatisfactory state of trade may accordingly prove premature and unwise, apart from all humanitarian considerations. Population questions generally, however, make long-range views and policies even more important. The admission of refugees to Great Britain or any other country cannot be wisely considered without regard to the imminence of declining population and its economic results, the consequences of which would appear to be almost completely ignored by the public and the Government alike. The problems of a declining population, with the consequent difficulties of economic adjustment, are in urgent need of scientific investigation and treatment. Industry, for example, has largely ignored the warnings about the effect of a lower birth-rate on the number of those leaving school and on industrial recruitment, and has scarcely begun to formulate plans to meet a shortage of juvenile labour which has been foretold for more than a decade. A scientific investigation of such problems and of the contribution which immigration policy might offer in minimizing some of the difficulties might well lead to a policy towards the admission of refugees both more generous and humane and more economic and scientific.

Sir John Simpson's report leaves no room for doubt as to the need for further impartial investigation of the questions which are linked up with the refugee problem. It may well make some professional associations uncomfortably aware of their own neglect or selfishness, or both. There is no single or simple solution save that of time, and the report should prevent premature or unsound conclusions being drawn from the solution of the problem of the Greek and Bulgarian refugees, for

example. Colonization on a large scale appears to be impracticable, but the problem would be reduced if more active steps were taken to train refugees in countries of temporary refuge, instead of maintaining them in idleness, and to pass them on to countries of permanent settlement as opportunity arises.

If, however, there are directions in which further investigation might yield invaluable results, the immediate problem, Sir John Simpson insists, is action. The machinery for Government action was created at Evian in July 1938, and the steps that are most urgently required are no longer those which can be taken by private organizations. The purposeful training of intending immigrants under good conditions which maintain their health and morale; the provision of capital for opening up areas not yet developed and for the necessary institutions of civilization are steps which can only be taken by Governments. Sir John believes that if Great Britain and France and some other European countries such as Norway, Sweden, Denmark, Belgium, Holland and Finland, were to agree to take a quarter of the potential refugees from Germany at once, and accommodate them if necessary in camps until they could be dispersed to countries of ultimate settlement, a substantial step would have been taken towards solution of the problem.

This considered judgment of the report that much more than private charity is essential does not, of course, imply that there are no longer directions in which such assistance should not continue to be given. Apart from their share in the work of the universities in the relief of refugee scholars, scientific workers have particular responsibilities in some of the fields of inquiry indicated above. They must be responsible for the conduct of some of the investigations, and pressure from them might well assist to stimulate the initiation of such investigations. Moreover, the report itself might well stir them to re-examine the narrow view of the problem which has characterized some of their professional associations.

Beyond this, scientific workers have the common interest of all citizens in the policy of their Government in this matter. The post-War immigration policy of Great Britain has been exceedingly cautious. It is at least open to argument that a more generous policy might prove in the long run to be wise and sound from the economic point of view, in that it might offer a contribution to the solution of the very serious problems with which we are confronted in the immediate future through our declining population; while there can be no question that the calls of humanity require us to do all within our power to alleviate the distress inevitably associated with the refugee problem.

Haldane as Strategist, Educationist and Philosopher

Haldane, 1915–1938
The Life of Viscount Haldane of Cloan, K.T., O.M. By Major-General Sir Frederick Maurice. Pp. xv+290+8 plates. (London: Faber and Faber, Ltd., 1939.) 18*s*. net.

HALDANE'S epitaph describes him, proudly but not unjustly, as "A great servant of State who devoted his life to the advancement and application of knowledge. Through his work in fashioning her army he rendered invaluable aid to his country in her time of direst need". The word "fashioning" is peculiar but possibly appropriate. Controversy turns on the use of the Army "fashioned" by Haldane. In 1905, when Haldane first took office, as Secretary for War, there was lack of co-operation between the navy and army on strategical questions. In January 1906, the question of co-operation with the French Army was raised, and Huguet brought back from the French War Office two proposals for the British Army: (1) *être liée à celle de l'armée française*, and (2) *se faire sentir dès le début des hostilités*. Colonel Lawrence, the uncrowned King of Arabia, says of the French that the only way to deal with them is to say "hoots" to them. Sir Henry Wilson, who became Haldane's principal adviser on strategical questions, was a francophile, more disposed to say this word to the politicians than to the French. Sir Edward Grey, on January 15, 1906, in a letter to Sir F. Bertie, British Ambassador in Paris, had said the word in diplomatic language —our military contribution "won't save France unless she can save herself". Haldane gave unflinching support to Wilson's strategy, notwithstanding strong opposition from Fisher and the 'blue water' school and from Lord Roberts and the conscriptionists. "Pussy", to give Haldane his nickname, turned tiger on occasion. Lord Riddell states in his diary that Mr. McKenna,

First Lord of the Admiralty, declined to provide transport for the 150,000 which Haldane proposed to land on the Continent, and records McKenna as saying: "Haldane put me out, but the scheme was a mad one and I did what was right. We had nothing to gain by making France the strongest power in Europe". To-day, as the author admits, "many people are of the opinion that it would be a fatal mistake for us to use our little Regular Army again to extend the line of a Continental ally at the outset of a War"; but refrains from expressing his own opinion on the question.

Was Haldane's strategy justified in the War of 1914–18? "It is then certain," the author writes with the support of a map, "that if our Expeditionary Force had not been ready for action by at latest the sixteenth day of mobilization (August 20) the left of the French line of battle would have been completely enveloped, and the German plan for the defeat of the French Armies by the fortieth day of mobilization successful, with the inevitable concomitant that the Germans would have been in possession of the Channel ports". Surely this is strategical science-atte-Bowe! Our "contemptible little army" was in position as arranged, "aligned" on the left of the French Army. A fateful decision! Haldane himself may have had misgiving. Lord Beaverbrook in "Politicians and the War" asserts that Haldane was not in favour of the dispatch of the Expeditionary Force to France; but evidence to the contrary is produced in the earlier volume of this biography.

After the War, Haldane was impressed by the need for co-operation between navy, army and air force and worked in this cause, especially during his second period of office as Lord Chancellor. Ramsay MacDonald's first offer (December 23, 1923) was the Education Office. In accepting the Lord Chancellorship, Haldane insisted on relinquishing part of the legal work in order to become chairman of the Committee of Imperial Defence. In a note written in 1925 he states: "I was convinced, and am convinced that the military advice given me was right and that our military problem in 1914 was to send the largest possible expeditionary force to support the French in the shortest possible time. For that I prepared". In a biography written by a distinguished soldier, we should have expected a full, expert, impartial examination of this question.

So much for Haldane as a strategist. Of his later educational work, some information is given. Haldane became president of Birkbeck College and of the Institute of Adult Education. In 1919, he reopened with the Minister of Education (Mr. Fisher) the question of the Bloomsbury site for the University of London. The offer of the site by the Government was an inept bungle. Haldane's road to the Valhalla of educationists was paved with good intentions, especially in relation to the University of London. He survived to see the site secured for the University by other men and methods. A quotation is given from Haldane's address on November 9, 1920, to the Old Students' Association of the Royal College of Science: "From this it will be seen", the author comments, "that he conceived of the University [of London] as constituting a union of colleges and of its future as depending in the main on the development of those colleges". This may be true of 1920; but was not the conception of the University for which Haldane pleaded eloquently in supporting the Bill of 1898 re-constituting the University as a 'teaching' university. "Professor Huxley was a distinguished advocate of the Bill", Haldane said in the House of Commons, "and gave evidence before the Royal Commission in which he laid down a scheme for a university which is now practically embodied in this Bill". 'Unify without fettering' was Huxley's slogan to define the relations of the University to its affiliated colleges. Supplementing the work of the colleges, he wished to see appropriate appliances for study and research, supplying London "with the analogue of the *École des hautes Études* and the *Collège de France* and the laboratories with the *Professor Extraordinarius* and *Privat Docenten* of the German Universities".

The author reveals that Haldane was "the prime mover in the institution of the University Grants Committee which now distributes more than £2,000,000 annually to the Universities of Great Britain". This committee, appointed by *fiat* of the Chancellor of the Exchequer, is a constitutional anomaly, for the Board of Education under the Act of 1899 is "charged with the superintendence of matters relating to education in England and Wales". In his book "Politics from Inside", Sir Austen Chamberlain records that Haldane in 1912 talked to him about the administration of the university grants. "He is trying to get them put under the Board of Education which he says has now been reorganised and has an admirable University branch through which he says they would obtain much larger grants". Chamberlain strongly opposed this suggestion. "I have always feared that the Board of Education would seek to impose their views on what ought to be taught upon the Universities and would stereotype the University courses: whereas the Treasury not being in this matter a department of specialists, was content merely to ascertain that the work carried on was of a University standard and that certain other necessary financial conditions were

observed". If, as we are assured, "every university in the Kingdom should remember him gratefully as the prime mover in the institution of the University Grants Committee", we may also be assured that every university will be grateful that his earlier suggestion of 1912 was not adopted.

Further, "every research student [should remember Haldane gratefully] as the instigator of the system of grants now distributed annually by the Department of Scientific and Industrial Research". This Department, established in 1915 as a War measure, should have been established before the War and Haldane was in a good position to put forward the suggestion. If Haldane was concerned with its establishment, the news is not surprising and redounds to his credit.

A few words may be added on Haldane as philosopher. Chapter v entitled "The Age of Relativity" is devoted largely to this subject. Haldane's first philosophical work was entitled "The Pathway to Reality". In May 1921, his "Reign of Relativity" was published, three editions being required in ten weeks, apart from translations into German, French and Russian. This book went far beyond the physical theory of relativity. The third book of the trilogy, "The Philosophy of Humanism", was based on his Donaldson Lectures at Trinity College, Dublin. His wide-flung search for reality brought him back to his own mind. "The real . . . is akin in its nature to our own minds, and it is not terrifying". In Emily Brontë's words:

O God within my breast
Almighty ever present Deity!

In triumph or tribulation, Haldane was comforted by his sense of divine immanence.

This book does not solve the enigma of Haldane. Must it be that the pathway to reality will never be trodden by an Englishman? Dr. McNair Wilson, a Scot, in his book "Doctor's Progress" makes some illuminating comments. He says of Haldane: "What interested me most however was the strong Scottish flavour of his mind. He was a Scot with all the weakness as well as all the strength of his people. Vain as only Scotsmen are vain; humble as only Scotsmen are humble. Proud and touchy, too, as only Scotsmen are proud and touchy". Possibly, he adds, men of his race never understand the English. "I am sure that the English never really understand the Scotch". One thing the Englishman will claim—the *wish* to understand a great man who "devoted his life to the advancement and application of knowledge" and "rendered invaluable aid to his country in her time of direst need". T. Ll. H.

Malayan Medicine

A Dictionary of Malayan Medicine
By John D. Gimlette. Edited and completed by H. W. Thomson. Pp. xvi + 260. (London, New York and Toronto: Oxford University Press, 1939.) 7*s.* 6*d.* net.

THIS dictionary has been prepared by one of the very few officers of the Malayan medical service who has regarded the study of native medicine as anything but time wasted on effete superstitions. Nor, in fact, are the modern hospitals of the western States of Malaya a proper environment for such studies, workers in them being insulated from the native atmosphere and fully employed in the study of modern medicine and surgery.

John Gimlette had the fortune to follow his profession in the medieval atmosphere of a delightful State remote until lately from high-roads and railways. To enjoy life in such surroundings, to keep the mind alert and to win the confidence of patients assured of the efficacy of time-honoured herbal remedies and by religion opposed to surgery, a medical man must have qualities of sympathy and understanding and be interested and intelligent enough to adapt to modern ends means on the surface unpromising. John Gimlette was such a man, and if Kelantan was fortunate to get such a doctor, he too was fortunate to discover his life's work in such congenial surroundings. Kelantan inspired his "Malay Poisons and Charm Cures", which has run into three editions, and now this "Dictionary", which has been the labour and solace of his last years, when he was crippled as a consequence of the practice of his profession. He died before it was completed, and the book was finished and seen through the press by Mr. H. W. Thomson, formerly of the Malayan Civil Service. Anyone who has ever written a dictionary will appreciate the labour and care Mr. Thomson has given to his task.

The dictionary will be invaluable as a work of reference for practitioners in Malay districts. For beginners, indeed, it is too elaborate and they will scarcely find the wood for the trees. They will, for example, have to know that before every plant name the Malay prefixes the work *pokok* "plant" or *daun* "leaf" and that *jarum*, for example, without

the word *pokok* means 'a needle' and nothing else. The dictionary includes not only the names of herbs, but also the names of parts of the body, of diseases, of magical and other medicinal treatments. A classified index has been provided by Mr. Thomson as some guide to those who may feel the need of an English-Malay dictionary.

The information under many of the headings like *kemenyan*, 'benzoin'; *ma'ajun*, 'electuary'; *jintan*, 'cumin' is encyclopædic; and the lexicographer gives some comparative data from Arabian and Indian medicine, but this line of inquiry especially in the field of Indian remedies could be much further extended. Oddly enough, Dr. Gimlette seems never to have read or heard of a translation by a Kelantan Malay of a medical treatise very popular with Indian Sunnis, the "Mujarrabat-i Dirbi", but as with his usual modesty he admits he had "only a practical and general knowledge of the Malay language", it is amazing that with that limitation he has produced two works of outstanding merit and permanent value. That such a work could be achieved by one who did not profess to be an expert linguist should be an inspiration to others, and one may hope to see some medical officer ready now to take up the study of the many manuscript and lithographed works that exist on Malay medicine.

No more appropriate subject could be found for a thesis or book by one of the Malays who have graduated from the Medical College, Singapore. There are numerous works on Indian medicine to hand for comparative purposes. More and more, research is discovering the debt that Malaysian culture owed to India both in the Hindu and Islamic periods, but of its debt in the field of medicine, which must have been very great, no study has yet been made. R. O. WINSTEDT.

Physical Science of Glass

The Properties of Glass

By George W. Morey. (American Chemical Society Monograph Series, No. 77.) Pp. 572. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1938.) 62*s.* 6*d.* net.

THE glass industry both in England and in the United States is to-day going ahead fast, a pleasing state of affairs which is believed to be due largely to the awakened realization that the soundest foundation for a strong industry is the understanding of its fundamental scientific principles.

The monograph under notice was commenced so far back as 1924 and began with two series of researches to provide necessary information for it, which was then lacking. It has thus been fourteen years in preparation. The literature quoted contains 781 references, of which 399, constituting more than half the total, refer to papers published since 1924; a statement which affords proof that the subject as it is to-day, treated with the aid of physical chemistry and based on physical properties as functions of composition, is largely new.

The result of all this work is an eminently scholarly and exhaustive monograph which is bound to be of immense value to the wide circle who have to do in some way or other with glass. The author's expert knowledge has enabled him to sort the wheat from the chaff in regard to the reliability of much of the information in the literature.

After some introductory sections, in which the history, definition and composition of glass are dealt with, the succeeding chapters, numbering sixteen in all, deal in turn with the various physical properties. Each is a veritable mine of information relating composition to a particular property. The chapters contain numerous tables, phase diagrams and a certain amount of mathematics with, of course, references to the original papers, which are conveniently arranged for quick reference in the old-fashioned way. There is a comprehensive index at the foot of each page.

The author early gives a definition of glass which is worth citing as showing the attitude of science towards it: "A glass is an inorganic substance in a condition which is continuous with, and analogous to, the liquid state of that substance, but which, as the result of having been cooled from a fused condition, has attained so high a degree of viscosity as to be for all practical purposes rigid."

The relation between composition and temperature with reference to the melting and crystallizing process in mixtures containing several components is nowadays compactly expressed by means of phase equilibrium diagrams which, to the competent, give a great deal of information. The word 'competent' is very necessary, for some of the diagrams are of extraordinary complexity; we commend particularly to the attention of followers of the phase rule since the early days of Willard Gibbs and van't Hoff, who used it to work out the formation of the Stassfurt salt deposits, the sketch of the solid model of the ternary system: Na_2SiO_3 — $CaO.SiO_2$ — SiO_2. This chapter,

entitled "Devitrification", affords an illustration of the progress which is being made in solving these abstruse problems with the aid of the phase rule; similar problems which concern the mixture of silicates present in igneous rocks are being studied in like manner and with remarkable success at the Geophysical Laboratory in Washington.

To many, the chapter on optical properties will be found of special interest; optical glass has been recognized as one of the key materials of civilization and an essential munition. Lens designers, who demand varying relations between refractive index and dispersion, have caused a wide search for suitable glass compositions, which has in turn led to the production of highly specialized glasses—for example, those which are transparent to X-rays and ultra-violet light, or conversely which are opaque to these wave-lengths: both are now articles of commerce. There can also be obtained coloured glasses which are opaque to all but a narrow spectral range. It is most convenient to have the data in regard to the action of glass on light collected in one chapter, and the extent of the information may be judged from the fact that no fewer than thirty-six optical glasses manufactured by Chance Brothers are listed with their optical properties and approximate composition.

The examples selected indicate the remarkable thoroughness of the book, which is well worth even the high price charged for it.

Experimental Psychology

Experimental Psychology

By Robert S. Woodworth. Pp. xi + 889. (London: Methuen and Co., Ltd., 1938.) 18*s*. net.

TWENTY years ago it was still possible to get the main results of the application of experiment to the problems of psychology within a reasonably small volume, and several excellent text-books were produced for that time. The rapid increase in the amount of published experimental work has made all such books out of date, and the teacher of experimental psychology has been forced to use seriously incomplete text-books and to supplement them in his teaching by his own knowledge of the technical journals. The task of making a single volume representive of the present position of experimental psychology seemed too laborious for accomplishment. This, however, has now been done by Prof. R. S. Woodworth, and his book will be welcomed by all students of the subject.

Prof. Woodworth has good qualifications for this task. It is particularly fortunate that he is free from a common tendency amongst psychologists to work under the banner of some particular school and to evaluate all work from the point of view of that school. The author's freedom from such fads enables him to deal fairly with experimental investigations of many different types and to recognize valuable work whether it is done by behaviourists or by *Gestalt* psychologists. At the same time, this catholicity of choice does not involve an absence of critical judgment. Few things can be duller than psychological volumes which are mere records of published researches, good, bad and indifferent. Prof. Woodworth seems to have used as his criterion for the inclusion of any piece of experimental work the fact that it makes a genuine contribution to the understanding of some psychological problem, and the general correctness of his judgment on this matter makes his book both useful and interesting.

If we treat the book as a survey of the present position of experimental psychology, we can find in it causes for satisfaction and a good many for dissatisfaction. This book should be a complete answer to those who complain that in the years since experimental psychology developed, nothing has been found out in psychological laboratories. There is, nevertheless, still much conflict about simple matters of fact, which is a result of the inconclusiveness of many published researches. Many experiments are carried out on too few subjects and with insufficient regard for the necessities of experimental design and of the statistical treatment of results. Very commonly the raw data from which the experimenter draws his conclusions are not published, so that no one else can ever determine how well justified his conclusions are. It is, for example, surprising to find in this book how many of the results of quantitative experiments are given as percentages without any indication of the actual numbers from which they have been derived. The methods of design and report of many experiments seem indeed to have been devised for the purpose of making it certain that no intelligible conclusion shall ever be drawn from them.

This, however, is a matter that is improving and it is to be hoped that severer standards in devising experiments and reporting their results will much lighten the task of a psychologist who, ten years hence, may try to make a new survey of the complete field of experimental achievement in psychology.

R. H. THOULESS.

A Text-Book of Inorganic Chemistry

Edited by Dr. J. Newton Friend. Vol. 6, Part 4: Arsenic. By Reece H. Vallance. Pp. xxxi+351. (London: Charles Griffin and Co., Ltd., 1938.) 25*s*. net.

THIS volume of a well-known text-book deals fully with the inorganic chemistry of arsenic. A special feature is the detailed description of the industrial preparation and uses of the various arsenic compounds. In most cases, sufficient detail is given of the experimental methods to make it possible to repeat them in the laboratory, a notable case being the preparation of arsenic hydride. The information is critically presented and is up to date. Very full references to the literature are given, and very few, if any, important papers can have been missed. The physico-chemical aspect is well represented, as, for example, in the very clear account of the rather difficult subject of the forms of arsenious oxide. The section on analysis is brief but full of useful information.

The volume shares with its companions the valuable feature of being equally suitable for reading by advanced students and as a work of reference. It speaks highly for the skill of the author that he has achieved this result, and the volume is one which should be in every chemical library. The editor announces in the preface that the original scheme of the whole work is now complete and that a new edition is in preparation in which, where the amount of new work justifies it, a separate book will be devoted to each element.

Electron and Nuclear Physics

By Prof. J. Barton Hoag. Second edition of "Electron Physics". Pp. x+502. (London: Chapman and Hall, Ltd., 1938.) 20*s*. net.

THIS is the second edition of the well-known "Electron Physics", which appeared in 1929. It is a remarkably up-to-date summary of the experimental aspects of atomic physics, with a bare minimum of the essential theory. Descriptions are given of nearly forty experiments which are suggested as suitable laboratory exercises; perhaps the most ambitious of these is an experiment on the disintegration of lithium by 50–70 kilovolt protons. It is obviously not the author's intention that any one student should work through the whole of the experiments, but there are very few students who could not learn a great deal by merely reading the detailed instructions and working out some of the numerical problems in this book. The text abounds in valuable practical hints, and in addition there are four special chapters on laboratory techniques (including high-vacuum, small-current, counter and high-voltage practice).

The text suffers frequently in elegance, and occasionally in clarity, from the concentration of so much matter into so small a bulk. This is, however, a most valuable book for the young physicist, and the reader is left with the impression that the physics students of the University of Chicago are singularly fortunate in the enthusiasm of their teachers and the equipment of their laboratories. H. R. R.

The Statesman's Year-Book

Statistical and Historical Annual of the States of the World for the Year 1939. Edited by Dr. M. Epstein. Seventy-sixth annual Publication: Revised after Official Returns. Pp. xxxviii+1508. (London: Macmillan and Co., Ltd., 1939.) 20*s*. net.

THIS indispensable statistical survey of the world follows its customary arrangement and once again in some fifteen hundred pages records an amazing array of facts. The British Empire and the United States fill the first two parts of the book, while the remainder—about one half in actual pages—is occupied by other States arranged in alphabetical order. As a rule the book is revised to March in the year of publication and so two European States appear as independent which have since lost that status. The careful revision of statistics from official sources gives this volume an authoritative standing which should make it invaluable in these days when world affairs are much in discussion and factual information is most desirable. Lists of official and unofficial books dealing with each State are a most useful aspect of the volume. There are coloured maps of Central Europe and of the country traversed by the remarkable Burma-China road between Lashio and Chung-king.

Concise School Physics

Electricity and Magnetism. By R. G. Shackel. Pp. viii+467–661. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1938.) 2*s*. 9*d*.

THIS is the third and final part of "A Concise School Physics", which is also available in a single volume. It carries the story well up to matriculation stage and contains 144 pages of copiously illustrated descriptive matter, about 34 pages of questions and answers, and four of mathematical tables. The general treatment follows good conventional practice and the writing is very condensed, so that the book reads like copious notes of excellent lectures supported by adequate laboratory work. The author, avoiding educational fads, has obviously striven to make his difficult story as straightforward as possible for beginners. The book is amazingly cheap at the price and it should prove very useful in class work which is being directed by a capable teacher.

Introduction to Physiological Chemistry

By Dr. Meyer Bodansky. Fourth edition. Pp. ix+686. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 20*s*. net.

Laboratory Manual of Physiological Chemistry

By Prof. Meyer Bodansky and Prof. Marion Fay. Fourth edition. Pp. vii+295. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 10*s*. net.

PROF. BODANSKY undoubtedly has a flair for writing students' text-books. These two volumes form a pair—theory and practical—suitable for senior medical students or for those taking degree courses in biochemistry or physiology. Both works are now in their fourth edition and are exceptionally good. J. C. D.

Aeroplane Controls*

By Prof. G. T. R. Hill, University College, London

MAN imposes his will on a machine by the use of a control. We are all familiar in a general way with the kind of control by which many of the machines which transport us from place to place are guided; the most recently arrived means of transport, the aeroplane, has controls which are much more complicated in their effects than we find with earth-bound transportation. The vastly greater possibilities of movement possessed by the aeroplane can be stated with greater precision if we consider the number of degrees of freedom it possesses, and then compare it with trains, cars or ships.

A train or tram running on a straight length of line has but one degree of freedom; it can only move along the line and it needs only a single control—that of speed. It is true that this speed control is usually shared between two controls, one of which is responsible for increase of speed and the other for decrease; but, as on a tram, these may be combined in one handle and are essentially one control. A car has three degrees of freedom, if we consider it when travelling in a wide smooth desert; it can move forwards, under certain conditions it may be skidded sideways, and it can be steered so that it turns about a vertical axis. The same limitations apply to a ship, if we think of a calm sea. In these two cases we find that two separate types of control are required—the speed control, which may be sub-divided as before, and the steering for controlling the direction about the vertical axis.

Coming now to the aeroplane, we find no less than six degrees of freedom. The aeroplane can move forwards, sideways and upwards, and rotate about three axes at right-angles to each other, that is to say, it can pitch, roll, and yaw.

We do not provide direct controls for each of these degrees of freedom any more than we do on a car or ship. The skidding or sideways motion of a car is controlled by special combinations of two controls, the steering and the speed. On an aeroplane four controls of the motion are provided; we control the three rotations and, in addition, the power of the engine by means of the throttle. This last control alters the thrust of the propeller, and on all modern types of aeroplane an air brake is provided which gives negative thrust, so that throttle and airbrake are essentially one control, similar in nature to the speed control on the tram.

Unfortunately, the three rotations are not usually each controlled by a simple movement of one control. Pitching by the use of the elevator is nearly independent of the other motions, but a turn is much more complicated, as it requires a proper combination of rolling and yawing and, on a steep turn, of pitching as well; not only this, but also the motion of pure rolling requires the application of both ailerons and rudder in due proportion, and so does the motion of pure yawing.

Coming now to the indirect control of vertical and lateral motion, we find that a pitching rotation changes the lift on the aeroplane and thus a rise or fall is obtained, though this is of course necessarily accompanied by the pitching rotation; in other words, it is not a simple motion in a given direction. Lateral motion, or sideslip, is produced by a special combination of aileron and rudder control, and with big sideslip the elevator control comes in as well.

The control of an aeroplane thus differs from that of a car or ship primarily in the fact that a much greater variety of motions is possible, and, further, to produce many of the simple motions a certain combination of various controls is needed.

We come now to a discussion of the relation between the movements of the pilot's hands and feet and the resulting motion of the aeroplane. There are three simple kinds of control which may be used; we may have a control of position, or a control of velocity, or a control of acceleration. To give everyday examples, the act of lifting a glass from the table to the lips is a direct control by the hand of the position of the glass; the rotation of the steering wheel of a car is a control of the rate at which the car turns, that is, of its angular velocity, and the pressure on the brake pedal is a control of its acceleration, in the negative sense. Each of these types of control is a reasonable one, though simple experiments performed with beams of light moved successively by the three types of control indicate that the position control is the easiest to manage and the acceleration the least easy.

However, it seems probable that real difficulty arises when a control changes its type with time. Take, for example, the aeroplane elevator control; if the stick is pulled back a little and held there, the first thing that happens is that the aeroplane has imposed upon it an angular acceleration in pitch; this falls away very rapidly, and leaves the aeroplane with a certain angular velocity, and

* From a Friday evening discourse delivered at the Royal Institution on February 17.

ultimately this dies away and the position of the stick controls the attitude and forward speed of the aeroplane.

These considerations lead us directly to a discussion of what qualities in a control are responsible for its being described as *pleasant*. I hold that we should go to great lengths to give pilots the easiest and most pleasant controls that we possibly can, so that by relieving their minds and bodies from all avoidable strain, they may be able to concentrate more fully and effectively on their other duties. A pilot coming to fly an aeroplane which is good on the controls will learn to fly it in the shortest possible time, undoubtedly a matter of tremendous importance in these days; when he knows it well he will love to fly it and will feel at one with his machine, and surely he and his mount will be a more effective combination for either peace or war than the pilot with poor controls, disgruntled, tired and at odds with his craft.

If we are agreed that it is worth while devoting time to a study of the characteristics of a pleasant control, we must admit straight away that while a test pilot, for example, has a very clear idea when he flies a new aeroplane as to whether the control is pleasant or not, he is in great difficulty in defining the quality he observes. While the pilot may describe the control as light, firm, crisp or free from lag, the designer always wants to know *how* light, *how* firm, and so on; in other words, he wants a definite answer in figures, and for all practical purposes so far he has been unable to get any figures which he can interpret usefully.

We are now entering upon dangerous ground, for in addition to studying the characteristics of the aeroplane we have to link up with those sensations that pilots like and dislike; the ancients thousands of years ago were well aware of the perils of attempting to argue about personal taste, but my view is that it is the greatest possible mistake to let this frighten us off the field, and aeronautical research should grapple boldly with these problems, even though they have been aptly described as being "not quite aerodynamics".

Experimental work is now in progress in Great Britain from which it is hoped that a foundation will emerge on which the designer may build up the control qualities of his new design with much greater precision and confidence than is possible to-day. An attempt will be made to codify a pilot's likes and dislikes, not only in general terms but also on a quantitative basis.

The ultimate object of the use of the controls of the aeroplane is to produce the flight path which the pilot desires, and in any quantitative study it is no good measuring the forces and couples which the controls apply without a knowledge of what has to be overcome by those forces and couples.

The functions of the controls may be regarded as four-fold, namely: (i) maintaining balance, or trim, in steady straight or curved flight; (ii) overcoming inertia when starting and ending a manœuvre; (iii) overcoming air damping, which usually resists motion, but in some important cases assists it in an undesirable way; (iv) overriding the natural stability or instability of the aeroplane.

The first function is well understood, because it is relatively simple to analyse steady flight conditions, and it is fairly easy to make measurements, both on models and also in flight, where there is plenty of time available for taking readings.

The second function of the controls concerns the relation of their power to the inertia of the aeroplane, and the effect of inertia depends of course on the rate at which manœuvres are carried out, and on absolute size, or size relative to the pilot, whose size is constant. These effects are familiar if we think for a moment of ships of different sizes and study their manœuvres. Small yachts turn quicker than large ones, and yachts turn about as quickly as aeroplanes of the same size, though of course the forward speeds of the aeroplanes are something like thirty or forty times as great.

It is not, however, in the steady rates of turn, but in the entering and checking of the turn that inertia shows its effect, and although large craft turn slower, inertia effects are greater than on small craft. On a liner, for example, it may take nearly half a minute to check the swing by reversing the helm on a steady turn, and it is this great time lag in the control which makes the operation of bringing a large liner alongside a quay under its own power a very tricky operation. A lag of even as little as a tenth of a second can be noticed in an aeroplane control, and bearing in mind that most aeroplanes have to be brought into relatively gentle contact with the ground at the end of each flight at speeds of the order of sixty miles an hour, lags of much more than a tenth of a second are quite unacceptable to the aeroplane pilot.

The third function of the controls, the overcoming of the damping of the fixed surfaces of wing, tail, etc., provides the general guide to the power required from the control organs; thus the movable elevator, which causes pitching, may be about half the size of the fixed tailplane, which resists or damps pitching motion. Proportions such as this have been reached as the result of long experience, but the harmonizing of the three controls, elevator, ailerons and rudder, still gives rise to a great deal of experiment of the hit-and-miss variety on new types, before they can be regarded as satisfactory.

Then finally, there is the relation of the natural or inherent stability, or instability, of the aeroplane to the power of the controls. I propose to illustrate this point by a homely example. In the case of a cyclist riding at a good speed, so long as his craft is endowed with good stability by virtue of its speed, the control movements of his handlebars are very small, but as the speed falls, so he has to work harder and harder in moving his handlebars more and more violently from side to side, until at last his fullest powers of control are inadequate and he crashes. Now this has a close parallel in the air, where stability deteriorates as the speed falls, just as on the bicycle, and it is always for the slow end of the speed range of the aeroplane that it is difficult to provide adequate control surfaces, particularly when it is borne in mind that these surfaces must also be capable of operation at the high-speed end of the speed range.

It is not possible to discuss questions of stability here in detail, but the intimate connexion which must always exist between stability and control can never, in my opinion, be too strongly emphasized.

This brings my discussion of the general considerations surrounding control problems to a close, and I would now like to refer to the results of some new experimental work and their bearing upon particular difficulties which have arisen from the great increase in performance of aeroplanes in recent years.

The trim and stability of a glider, or of an aeroplane gliding with its engine shut off, present no great difficulties to the experienced designer. When the aeroplane is flying under power, the slip-stream from the propeller passes first over the wing and later over the tail-plane, changing the air forces on any surface with which it comes into contact. Experiments with models show that the slip-stream from each propeller, by the time it has reached the tail-plane of a representative modern type of twin-engined aeroplane, has a nearly flat under-surface. This provides an explanation of why two different types of aeroplane, which may look very similar, behave quite differently in flight. In one case it may be that the tail-plane is below the bottom of the slip-stream, and thus experiences only the air pressures arising from the normal speed of the aeroplane through the air; in the other case, with the tail-plane just in the slip-stream, the air forces may be more than twice as great and the upsetting effect of this on fore and aft balance, or trim, is obvious.

The sizes and speeds of aeroplanes are rapidly increasing as the years go on, and the reason that the aeroplane pilot has not yet found salvation in a power-assisted, or servo, control is to be found in the danger involved if there is lag in the mechanism. The very minute degree of lag which is tolerable has already been referred to, and by a continuous exploitation of the possibility of aerodynamic balancing of the control surfaces, it has, up till now, been possible on even the biggest types to avoid the need for a servo-mechanism at all. But yet closer aerodynamic balancing will be needed in the future, and a new system has recently been invented by several people in different countries almost simultaneously.

The control flap has its hinge situated well behind the leading edge in the familiar way, but that part of the surface in front of the hinge is entirely shrouded by curtains formed by extensions of the top and bottom surfaces of the main wing, extending back almost to the hinge, with a small gap or vent at top and bottom between their extremities and the moving control surface. The front part of this surface thus works in a kind of box, and the pressure on top of it is controlled by the air pressure existing outside the wing at the position of the top vent, and similarly for the under side; the essential point is that the box is divided into two parts, sealed from each other by

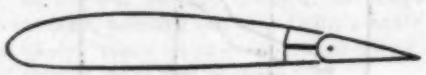


Fig. 1.

the nose of the control surface, which touches at all points in its travel the curved back of the main wing (Fig. 1). The absence of any air flow through the gap which usually exists between control surface and wing is found to avoid the undesirable pressure changes which usually arise on the nose of the control surface as it moves, thus spoiling the balancing over anything but a small angular range. Irving, of the National Physical Laboratory, has been one of the co-inventors, and the results of his first experiments are most promising.

Another development which, like the tricycle undercarriage, is a revival of an old idea and goes back, to my knowledge, to 1904, when it was embodied by the Wrights in one of their patents, is what is known as the *two-control system*. The standard system of to-day, with the three controls, elevator, aileron and rudder, is universal in all countries; at various times attempts have been made to abolish either the ailerons or the rudders. It seems, however, impossible in the light of modern knowledge to design an aeroplane which can carry out perfect turns at all speeds with either a rudder only or ailerons only, and an interesting new arrangement is being tried by a well-known American aeronautical engineer, Weick, of the Engineering and Research Corporation, of

Washington, D.C. Weick connects up both the ailerons and the rudder to a single control wheel, the rotation of which operates them both in a pre-arranged proportion. By this means it is possible to make nearly perfect turns at one speed and very satisfactory turns at all speeds. Encouraging results have attended the early trial flights, in which an experienced test pilot observed that he got smoother riding in bumpy weather with the two-control system than with the standard three controls. If the early promise of this experiment

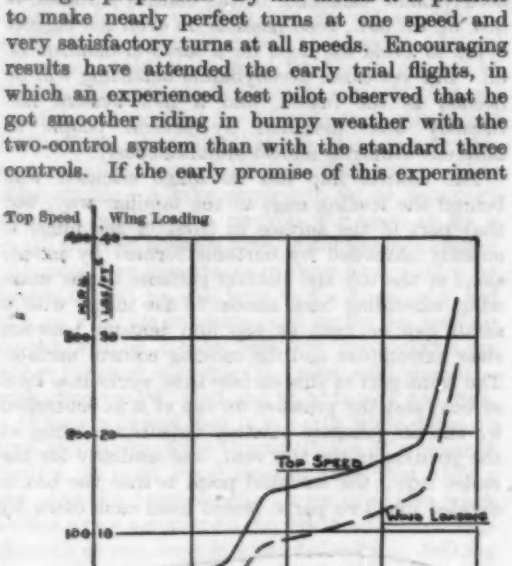


Fig. 2.

is fulfilled, a real advance in simplification of control will have been made, and with the increasing complication of everything connected with the aeroplane, a fundamental step in the opposite direction, such as that proposed by Weick, will be most refreshing to the hard-pressed pilot.

In order to minimize the very real danger of the first test flights on large new types, there is a procedure which has been adopted, notably by one firm in Great Britain, Messrs. Short Brothers, which consists of building a *flying model* of the large aeroplane. This flying model may be something like half the size of the projected type, and its weight would then be only one-eighth; the control forces are in that case reduced to one sixteenth, and the pilot thus has no difficulty in managing his model. It is of course far quicker and cheaper to modify the model to correct any faults in trim and stability, and it is possible to ensure that the control forces on the full-size aeroplane are within the capacity of the pilot's strength. Then minor modifications should suffice to harmonize the controls and achieve the high standard which we know is possible of attainment.

The large types built by Shorts, just referred to, are the "Empire Boats" and their Service counterparts the "Singapores", and the flying model was known as the "Scion Senior". Although this latter type was fitted with floats, nevertheless the wings and tail, including all control surfaces, were used as the basis for the design of its larger counterpart; the flying model must take its fair share of credit for the remarkable ease of handling in the air which is characteristic of these fine boats.

The thought may perhaps arise that I am exaggerating the importance of the role taken by stability, and particularly by control, in the advance of the science and art of flight. I have prepared a diagram (Fig. 2) showing the rise in speed, the common criterion for judging progress, and also in wing loading, showing what has been accomplished in the last thirty-five years. It will be seen how speed and wing loading have risen together in such a way that it is impossible to dissociate one from the other, and I hold that it is only through improvement in stability and control that we can now attain the speeds we do by flying safely with wing loadings twenty and thirty times as great as those of the most famous aeroplane of all time—that in which the Wrights made their first flights in 1903.

The Ordnance Geological Survey: Its First Memoir, 1839

By Dr. F. J. North, National Museum of Wales, Cardiff

IN the spring of 1839, R. A. C. Godwin-Austen commenced a letter to H. T. de la Beche with the following words: "I am not much in the habit of buttering my friends, but in the present instance you must not complain at being compelled to pay for a shillings-worth of that commodity". (A shilling was the postage charge for a letter from Newton Abbot to Swansea.) The writer then described his efforts to secure a copy of de la Beche's "Report", and continued, "I read it before dinner and after: I dipped in it with my tea, and went on devouring it until the 'dead hour'. I was at it again this morning. . . ."

The reference was to the "Report on the Geology of Cornwall, Devon, and West Somerset"—the first volume to be published on behalf of the newly founded Ordnance Geological Survey. It was de la Beche's own idea to supplement the

maps by descriptive memoirs, and Colonel Colby (superintendent of the Trigonometrical Survey) had stipulated that "Mr. de la Beche shall undertake and at his own cost and risk, to publish all these . . . Geological Sections, Memoirs and other matters which may be necessary to illustrate the use of the map, where geologically coloured", but, as shown in a previous note[1], de la Beche had his own way of dealing with the authorities, and the report was eventually published "By order of the Lords Commissioners of Her Majesty's Treasury".

The present note relates to a controversy that arose while the report was being prepared, and by reason of which the work of the Ordnance Geological Survey nearly came to an untimely end.

When de la Beche was surveying in Cornwall, he received a letter which greatly disturbed him. "I am sorry," wrote Colby, "to have to tell you that extremely unpleasant reports of the inaccuracy of your Geological Survey are in circulation, and have got into quarters where the want of geological information renders it difficult to rebut them. . . . Who is the author of these reports I cannot ascertain, but they can only be effectively met by bringing the work forward and shewing its utility. . . . The Government feel that they have paid for a portion of work, which is not before the public, and when the work is impugned they dread their responsibility."

De la Beche lost no time in replying, and his letter contained these paragraphs: "The reports in question arose out of a paper by Messrs. Sedgwick and Murchison, read before the British Association held at Bristol, in which they differed from a copy of the Ordnance Geological Map of North Devon, with which Gardner inadvertently furnished one of these gentlemen, such map being unpublished at the time. . . . The indecent attack . . . the cause of all the present reports, was therefore made without giving me any notice of the subject, and while the Geological Map of N. Devon and the Report were still unpublished. . . . By your kind letter, my dear sir, it is but too clear that I have personal enemies, and unfortunately it is equally clear that they are actively employed against me. While I toil day after day without rest, endeavouring to do my duty to the public, and to return zeal and the best use I can make of my abilities for the confidence reposed in me, they can, and as it appears do, buzz their accusations about, not neglecting the quarters where they conceive they can do me the most mischief, so that do what I will I have no chance. . . ."

From Colby's letter and de la Beche's reply it might appear that Sedgwick and Murchison were the instigators of an attack on de la Beche and that the campaign had been carried out of the geological debating room, where it really belonged, to official circles, where it was calculated to jeopardize the continuation of the Survey. Actually, however, the matter provides an excellent illustration of how misunderstandings arise, and how serious they may become if one of the protagonists is inclined to interpret honest criticism as a personal attack.

As an example of the news that de la Beche was getting, we may take this letter (from a person whose writing I have not yet identified): "I heard from various quarters some time ago that they were persecuting you, and suspected that Lyell and Murchison were at the bottom of it. I went to Greenough to ask him. He told me you were safe, but that Spring Rice [that is, the Chancellor of the Exchequer] had been informed of the truth, and that you would be well looked after. . . ."

George Bellas Greenough, who was president of the Geological Society in 1834 when the first geological maps of Devonshire were published, seems to have done all in his power to smooth away the difficulties, and persuaded de la Beche not, as he was at first inclined, to resign his appointment, pointing out that Colby's letter had very likely "made us more apprehensive of mischief than there is any occasion for".

The bone of contention was that de la Beche had regarded the Culm deposits of Devon—rocks which contain layers of anthracite-like coal, and fossil plants like those of the coal measures—as a member of the 'Greywacke' series, which in other areas was known to underlie, and, therefore, to be much older than the Carboniferous strata.

Finding that the Culm beds seemed to pass downwards without interruption into the undoubtedly older rocks beneath, de la Beche argued that the presence, in the Culm, of plants like those in the coal measures, did not mean that the rocks were contemporaneous with the coal measures, but that the coal-measure plants came into existence much earlier than some geologists supposed, and when he stated as much in his "Geological Manual", published in 1832, Murchison contested the view, and offered to help him to re-write the relevant chapter. He knew, therefore, that Murchison, at least, did not agree with him.

Two years later, de la Beche re-affirmed his views in a communication to the Geological Society, when he was again criticized by Murchison. "You will have heard from Greenough," wrote Edward Turner, the secretary, "how your discovery of coal and its fossils in the greywacke was last Wednesday turned topsy turvy without scruple. . . . Murchison, in fact, said that he had never seen the country, but would nevertheless take upon himself to affirm, so identical were

the fossils with those of the ordinary coal fossils, that your coal also belonged to the Carboniferous beds. . . . Murchison clearly thinks it impossible for the fossils of the carboniferous coal field to occur below his Dudley (that is, Silurian) beds".

Sedgwick, at this period, agreed with de la Beche, and wrote that he had always supposed the Devon anthracite to be in the Greywacke, and was not surprised to learn that the plants were identical with coal-measure fossils. He concluded by saying: "The fossillogists are going Mad. The foundation of our Conclusions . . . must ever rest on the evidence of superposition, given by actual sections. Our friend Murchison has examined an astonishingly fine series of upper fossiliferous greywacke, and finding no coal plants in it, resolved in his own mind that the said plants should not be found in it anywhere else."

The note read at the meeting of the British Association was followed up by a paper read before the Geological Society in 1837, and in the meantime the matter had given rise to much discussion. Lyell, who had succeeded Greenough as president of the Society, had written to de la Beche, asking him to re-consider his position. Among other things he said: "In any district of much disturbed strata the admission of such an anomaly as the identity of the vegetation of two very remote eras on any grounds which were stated seems to me unphilosophical. . . . If you are prepared to say you have changed your mind, pray give me the opportunity of saying it on your authority in my speech."

All this shows that neither Murchison nor Lyell wished to take an unfair advantage of de la Beche; it simply means that they thought he had made a mistake, and said so in the proper place for such views to be expressed.

Unfortunately, de la Beche was working so far away from London that he had few opportunities for meeting kindred spirits, and he was often, as his letter to Colby suggests, physically tired. Moreover, as the owner of plantations in Jamaica, he had suffered as a result of propaganda connected with the slave trade, which, in the words of Caroline Fox, had given him a "low view of mankind". In the circumstances, it is not surprising that he should have imagined the worst when he received Colby's letter, and learnt that he was being criticized in geological circles.

Although in a half-hearted way de la Beche eventually adopted the identification of the Culm proposed by Sedgwick and Murchison, there are passages in the report which indicate that he was not really convinced that the evidence of fossils could be regarded as determinative, when the field evidence appeared to point to some other conclusion—all of which goes to show the danger of dogmatism when scientific principles are under discussion.

In the controversy to which this note relates, we find doubt being cast upon a principle that Robert Hooke had conceived towards the end of the seventeenth century, that William Smith had enunciated towards the end of the eighteenth, and that is now recognized as the foundation of modern geology: namely, that the assemblage of fossils in a given series of strata is peculiar to rocks of that age, so that strata can be identified by the fossils which they contain.

[1] NATURE, 143, 254–5 (1939). The present note, also, is based upon manuscripts deposited in the National Museum of Wales by the late Colonel J. I. D. Nicholl of Merthyr Mawr.

The Study of Animal Behaviour

THE study of animal behaviour has a long and arduous history. It cannot, however, be claimed that either the scope of the subject, or its methods, have been clearly defined. In interest it ranges from the ecological facts of the interaction of animals and their environments, through the details of life-history and their physiological analysis, on to questions of perception, motivation, learning and adaptive behaviour. Its methods embrace those of the field-worker, those of the physiologist, and those of the psychologist. Its philosophy, again, is in some quarters undefined, in others aggressively, even if vaguely, teleological and organismic, and elsewhere frankly empiricist. With all this diversity, those outside the subject can scarcely regard it as more than a concatenation of discrete interests and different methods. For the same reason, those within it can scarcely be blamed if their activities cover but a very narrow part of the whole subject. Nevertheless, ever since the turn of the century attempts have been made, in societies and journals abroad, to integrate what is, after all, a distinct, even though very wide, field of scientific exploration.

Great Britain has not been to the fore in this work. Indeed it was only three years ago that a society relating to the subject was founded here for the first time. This society, the Institute for the Study of Animal Behaviour, has as its aims "to promote the study of animal behaviour, to encourage the undertaking of research and the publication of the

results of research in this field", and to carry on any further activities which it may from time to time regard as furthering these objects. It publishes a *Bulletin* which is devoted to reviews of recent advances in the study of animal behaviour, and it also provides research grants to investigators. Occasionally, too, it holds meetings, and it was at one of these meetings, held on June 13 in conjunction with the Zoological Society of London, that Dr. Julian Huxley briefly outlined the aims of the Institute, of which he is president, in the opening remarks to a symposium which dealt with modes of analysis of animal behaviour.

The topics considered in this symposium were perception, motivation, instinct, learning and memory, and in some measure at least the discussion thus emphasized the main compartments of animal psychology. Perception is of primary importance at every level of behaviour. It is the starting point of the responses which animals are constantly making to changes in their immediate surroundings. The methods by which it needs to be analysed are as varied as the forms which it can take. Vision, for example, has to be studied in terms of brightness—discrimination and form and colour perception; and apart from the mere statement of the kind of vision possessed by any given animal, the problem has to be explored from the point of view of the anatomical and physiological mechanisms which subserve these functions—mechanisms which are by no means necessarily the same in different species. Auditory acuity, tactile and thermal sensitivity, to mention just a few other perceptual modalities, each requires its own comprehensive mode of analysis. The particular perceptual problem dealt with at the symposium—insect communication—showed clearly how complicated a process of analysis can be, and how much the perceptual world of one animal may differ from another.

Some insects, as Dr. A. F. Rawdon-Smith pointed out, can discriminate between sounds which differ by a factor other than intensity. Quite clearly they discriminate the quality of a given sound by a process altogether different from human frequency discrimination. For example, a virgin female cricket will react to a telephone that is transmitting the chirruping of a male even when the sound is so distorted as to be unrecognizable to the human ear. Since no insect possesses a cochlea which could subserve harmonic analysis, the only possible basis of discrimination is that different sound qualities produce afferent impulses of different temporal pattern in the auditory nerves. But here, as Dr. Rawdon-Smith explained, a major difficulty is encountered. Owing to the refractory period of the nerve fibres, it is to be expected that they would discriminate only low frequencies, whereas in fact study of the passage of impulses shows that the auditory receptors of insects are incapable of responding to such frequencies and react only to frequencies of much higher magnitude. The solution to this problem was obtained by means of a carefully designed physiological experiment carried out by Dr. R. J. Pumphrey and Dr. Rawdon-Smith. It was found that the high frequencies given out by stridulating insects are carriers for a low-frequency modulation. High-frequencies themselves have no 'meaning' to insects. Their function is to carry the low-frequency modulation, and it is the latter which characterizes sound to the animal. The mechanism of auditory perception in insects is thus much less akin to that in man than it is to wireless telephony.

Dr. Rawdon-Smith's exposition was an eloquent demonstration of the possibilities of analysis of perception, and of the immense field that awaits exploration. No animal's perceptual world can be regarded *a priori* as being the same as another's. Things which are significant in one world may not be perceived in another, and each perceptual world presents its own problems of organization. The latter have been closely studied, particularly by *Gestalt* psychologists and philosophers, but while the primary issues have at times been obscured by generalities, the actual facts regarding different perceptual worlds in the animal kingdom have always remained the central problem of students working in this field of animal behaviour.

This has not always been the case with animal motivation, for here general issues have frequently obscured definite problems. The study of animal motivation is concerned with the central and peripheral nervous organization which makes response possible, and with the working of this nervous apparatus; with the analysis of other influences, for example hormonal factors, which affect behaviour; and with the definition and measurement of the various 'drives' for the fulfilment of which animals strive. The latter has been a fruitful field of experimental psychological exploration. The investigation of the part played by hormones has also yielded facts of great interest, even though the actual manner in which hormones affect behaviour has not been elucidated as yet. On the other hand, the neurological aspect of the problem has been left mainly in the hands of anatomists and physiologists, in spite of the fact that the fundamental issues of nervous physiology must form the primary facts of a study of behaviour. That they do has, of course, been generally admitted by students of behaviour, but in so far as they have not been immediately concerned in this field of study, animal psychologists have been content to base general theories of behaviour on concepts derived, for example, from the field of

reflex physiology. The rigid 'behaviourism' of Watson was one such general theory. While it did much to organize knowledge of behaviour and to attract attention to the subject, it was far too static in its formulation to survive in the face of a growing volume of facts. Its history, too, exposes the danger of a general theory being so formulated that it does not take into account the possible changing nature of the ideas on which it is based.

This issue was vigorously dealt with by Mr. J. Z. Young, who compared the incorrect conception of a reflex system as something which operates whenever its afferent side is stimulated, with a reflex system in which an afferent impulse becomes effective only when the motor neurons of the system are in a particular state of excitability due to impulses reaching them from other neurons with which they are in synaptic connexion. He went on to consider the importance of the fact that the higher nervous centres are in constant activity. For example, in cephalopods the anatomical arrangements are such that certain combinations of afferent stimuli can set in action self-re-exciting chains of neurons, the continued activity of which facilitates certain pathways. His suggestion is that the setting-up of such activities may constitute the change which takes place in a nervous system during the process of learning. Mr. Young's paper made it perfectly clear that the old analogy of the nervous system as a static telephone exchange which passes on messages to the relevant motor neurons must give way to a conception of an exchange always in active change itself.

Although general theories of behaviour that are based upon neurological concepts may even yet be inadequate, they are much more valuable to animal psychology than discussions as to the reality of concepts such as instinct. Dr. J. A. Loeser's contribution to the symposium, which was substantially the same as an article of his published in NATURE of May 27, p. 880, was concerned with this question, and unfortunately his attempt to banish the concept in favour of even less tangible concepts of behaviour cannot be regarded as a successful one. Dr. Loeser's main point is that every organic action represents merely the satisfaction of an impulse, and that in so far as no response of an animal can have any conscious or unconscious relation to self- or race-preservation, it cannot be an instinctive action; therefore there is no such thing as instinct. A hen, for example, does not sit on eggs because she wishes to hatch the next generation of hens, but because sitting on cool curved objects soothes irritating surfaces of her body. This may all be very true, but the fact remains, as Dr. Loeser admits, that whatever the basis of so-called instinctive behaviour, subjective aims and objective purposes often appear to coincide. The argument is purely one of definition. Instinct is widely defined as that faculty, other than a rational process, which makes inborn animal behaviour seem purposive. As Prof. Lashley effectively argues in a recent article, "the anti-instinct movement was aimed primarily as the postulation of imaginary forces as explanations of behaviour". It scarcely helps the subject to dismiss the presumed hereditary basis of instinct, and to continue talking, as Dr. Loeser does, about the "psyche and consciousness", or the "genuine risk and genuine reflection" of behaviour.

Fortunately, the learning processes and adaptive behaviour of animals lend themselves to a more satisfactory type of generalization than the unlearned reactions which usually go by the name of instinct. The literature on this question is extensive, and the experimental work which is being carried out is as a rule sufficiently well designed to allow of the constant re-testing of the general theories of learning which have been derived from previous studies. An excellent example was given by Mr. G. C. Drew in his contribution to the symposium. One of the well-known theories of learning is the Law of Effect, which states that reactions which are rewarded tend to be stamped in, while those which are punished tend to be eliminated. This hypothesis has been thoroughly substantiated so far as rewards are concerned, whereas recent work has thrown considerable doubt on the part which punishment is supposed to play in the process of learning. Indeed, work by Drew and others has shown that where an electric shock is the punishment in experiments on rats, a mild shock has an equally facilitative effect on the speed of learning whether it be given for the wrong response or for the correct response, whether it be associated with both types of response, or whether it be associated with the reward.

Experiments of this kind are still not as numerous as they might be, nor as consistent with each other as is to be desired, but they are representative of an approach in the analysis of behaviour which is truly fruitful. So, too, were the experimental studies on delayed reaction and memory reviewed by Dr. S. Zuckerman. These concerned the ability of animals to make a discrimination between an incorrect and a correct stimulus when their responses are separated from their perception of the problem by intervals of varying length. Other experiments which were described dealt with the observation that chimpanzees can be taught to regard disks of various sizes and colours as symbols for specific foods. The fact that the animals will work for these disks, fight or beg for them, and hoard them, even if it

be only for a day, until they have the opportunity of exchanging them for the foods they represent, raises a considerable question from the point of view of the genesis of abstract and symbolic behaviour.

If it succeeded in nothing else, the symposium undoubtedly did indicate to those who were present the vast field of interest which can be defined under the term 'animal behaviour'. It is clearly impossible for any one science to deal with all aspects of this subject. This very fact is one of the best arguments for the existence of an organization, such as the Institute for the Study of Animal Behaviour, prepared to undertake the task of integrating the numerous studies, carried out in different departments of science, which are related under the heading 'animal behaviour'. The task that lies before the Institute is, however, far more than just the reviewing of separate advances in the subject, for this activity cannot but lead to the more responsible one of indicating the lines along which research needs to be directed.

Obituary Notices

Dr. Jan Koliha

THE National Museum of the Kingdom of Bohemia, at Prague, has suffered an irreparable loss in the untimely death of Dr. Jan Koliha, head of the Palæontological Department of the museum since 1931.

Dr. Koliha was born on May 3, 1890, at Police nad Metuji in Eastern Bohemia, where his father was a teacher. He had already begun collecting natural history specimens in his teens, and when he proceeded to the Charles University of Prague, in about 1900, he studied natural science and obtained the degree of Ph.D. for a dissertation on "The Atremata of the Krušná Hora Beds" (published in *Palæontographica Bohemiæ*).

Koliha next became assistant in geology and mineralogy to Prof. Cyril Purkyně at the Technical University, and also at the National Museum under Prof. Perner. The latter advised him to abandon his studies of the Bohemian Cretaceous and devote himself to the Palæozoic strata of his country, which are well represented to the south and south-west of Prague.

While still a student Koliha had made the acquaintance of the great zoologist and palæontologist Prof. Antonín Frič, who died in 1913. Frič lived to see the collections of the National Museum removed to the fine buildings at the top of Wenceslas Square (1892). Here Dr. Koliha, together with the late Dr. J. S. Procházka, acted as assistant to Prof. Kafka. On the death of the latter (1929), Dr. Procházka became the head of the Palæontological Department until his death in 1931, when Koliha succeeded him. From this year the galleries containing Barrande's collections were called the Barrandeum, and Koliha was given the title 'Custodian of the Barrandeum'. He likewise became responsible for all the palæontological collections, with the exception of fossil plants, which were under the care of Dr. Němejc.

Dr. Koliha was the chief authority on the Lower Palæozoic fossils of Bohemia. He is especially to be remembered for his research on the Tremadocian of Eastern Bohemia (1925). Drs. Kodym and Matějka of the State Geological Survey had found black clay shale near Český Brod (East Bohemia) in a locality hitherto supposed to be Cretaceous. Dr. Koliha examined some of the material and on the basis of the contained fossils proved it to be of Lower Ordovician age. Later he succeeded in correlating it with the Tremadoc Shales. An account of this discovery is given in the *Journal of the State Geological Institute of C.S.R.*, vol. 2, pp. 305 ff. The importance of this discovery was shown by the fact that it placed the Ordovician fauna of Eastern Bohemia in quite another sea to that which existed in the Barrandian basin at the same time. The Tremadocian of East Bohemia belongs to the Baltic-Scandinavian facies.

Dr. Koliha was well known and honoured not only in his own country, but also in Great Britain, Germany, Sweden, and the United States. As a specialist in the older Palæozoic he was unrivalled, and material from all over the world came to him for determination. He was likewise a good zoologist. He possessed a surprising knowledge of English literature. He was also acquainted with Swedish and Welsh, and spoke excellent French.

Dr. Koliha was a kind friend and a good colleague. He was for many years a member of the Geographical Society of Prague, of the Geological and Mineralogical Society of Czechoslovakia and also of the National Museum Society, to the meetings of which he contributed many inspiring lectures and other communications on palæontological matters. He died on April 7, after long suffering. His place at the Museum has been taken by his colleague Dr. Němejc.

I am indebted to Prof. Perner of the Charles University and to Dr. F. Prantl, of the National Museum, for some of the details of Dr. Koliha's work and career.

T. OAKES HIRST.

WE regret to announce the following deaths:

Dr. E. T. S. Appleyard, research assistant in physics in the University of Bristol, on June 15, aged thirty-five years.

Prof. A. E. Kennelly, emeritus professor of electrical engineering in Harvard University and the Massachusetts Institute of Technology, on June 18, aged seventy-seven years.

Dr. E. Kidson, O.B.E., director of meteorological services in New Zealand since 1927, aged fifty-seven years.

News and Views

Prof. Walther Nernst, For.Mem.R.S.

ON June 25, Walther Nernst, well known as a physical chemist, will celebrate his seventy-fifth birthday. Nernst was born at Briesen, West Prussia, and studied at the Universities of Zurich, Berlin, Graz and Würzburg. He worked under F. Kohlrausch at Würzburg, where he took his degree. His thesis connected his name for all time with the thermomagnetic effects he had discovered. Eventually, he became professor of physical chemistry in the University of Göttingen and principal of the laboratory that he had just equipped for this branch of study. Numerous papers dealing with a diversity of problems were published as the result of work in the new laboratory, among them such subjects as the ionic theory of solutions, electrocapillary phenomena, residual current, polarization capacity, over-voltage, the lead accumulator and the theory of nerve stimulation which explains the painlessness of the application of high-frequency electric currents, known as diathermy. The invention of the Nernst electric lamp made the name of the young physicist well known all over the world. In 1924, Nernst became president of the Reichsanstalt. His "Textbook of Theoretical Chemistry", the fifteenth edition of which has recently appeared in Germany, is well known all over the world and has been translated into several languages. During the Great War he spent some time at the front and was decorated with the Iron Cross of the first and second class. In 1920, he was awarded the Nobel Prize for chemistry. Prof. F. Krüger has written an appreciatory article in the May issue of *Research and Progress* (Berlin, N.W.7, Unter den Linden 8) on Nernst's life and work, filled, he says, with most intensive labour but richly rewarded in respect of research and teaching.

NERNST'S work covers many fields of theory and investigation. His theory of galvanic cells, published in 1889, in which he applied the new theory of ions to the explanation of the development of electromotive force and introduced the idea of an electrolytic solution pressure, still forms the basis of the theory of the cell. Equally important was his study of the theory of the diffusion of electrolytes and the development of the formula for the liquid contact potential (1888–89). The application of the quantum theory to physical chemistry interested him greatly, and his experimental investigations of the specific heats of solids at low temperatures laid a sound basis for one aspect of this theory. Among other important results was the fact that the specific heat of diamond becomes vanishingly small at low temperatures. This result was a consequence of Nernst's so-called Heat Theorem, or the Third Law of Thermodynamics, which he put forward in 1906. This has the most fundamental importance in chemical thermodynamics and gave a new impetus to theoretical and experimental studies in this field, in which a large number of workers in all parts of the world took part. Another example of Nernst's insight into fundamental problems was his enunciation of the so-called chain mechanism of photochemical reactions, published in 1918. There is scarcely a branch of modern physical chemistry which has not been enriched by some important contribution from Nernst, and his influence on the development of the science has been most fruitful. His insistence on the equal importance of thermodynamics and the atomic theory at a time when the latter was beginning to fall into discredit in some quarters is a tribute to his sound judgment. As an investigator and as a teacher he stands out as one of the great leaders in science.

Plaque in Memory of Edward Clodd

THOSE who knew Edward Clodd personally and the multitude who were instructed by his numerous books and articles will welcome the placing of a plaque on June 15 on Strafford House, his Aldeburgh home during 1889–1930. It was here that he kept his library, where he spent all his spare time, and to which he retired. Strafford House recalls many pleasant and stimulating occasions to those who were privileged to be Clodd's guests. Throughout a long period Clodd invited mixed gatherings of men of very varied interests—literary men who had made their mark in different ways; leading men in other departments of learning, law, history, economics, and politics; administrators of Protectorates, Colonies, and the like; men who had come to the front rank in chemistry and physics, biology, anthropology, and archæology. Any particular gathering contained representatives of some of these intellectual activities, each of whom blossomed out under the hospitality of the genial host, whose far-reaching interests embraced most aspects of the humanities and sciences. Not only were the talks and discussions memorable, but also the walks and especially trips in the little yacht the *Lotus*, where Clodd busied himself with sailing and in ministering personally to the material needs of his guests. Strafford House thus became a pleasant meeting place for men and women of varied pursuits and was a transient intellectual centre that had a definite social value for some forty years.

Museums and Schools

AN exhibition designed to demonstrate some of the opportunities for co-operation in function between museums and schools in the work of education opened in the Department of Archæology and Egyptology of University College, University of London, Gower Street, London, W.C.1, on June 20 and will remain open daily until July 15. The material exhibited

has been contributed, mainly from their publications, by the museums of London and of the United States of America. It serves to bring out with considerable clarity the very different approach by the museums of the two countries to the problem of education. In London, largely owing to the manner in which the great national collections originated, and the way in which they have been built up, emphasis is laid on the function of the museum as a store-house of research and advanced critical appreciation, as well as, of course, as a place of exhibition of such part of the national wealth as is embodied in objects of artistic or historical interest and value concentrated in London. In the United States, on the other hand, the museums rely almost entirely upon funds from unofficial sources, whether from endowment or in the form of current income. In consequence, the latter have consistently stressed their educational function, directing it, naturally, in the first instance to the satisfaction of the interests or needs of their more immediate clientele.

THIS difference is to be noted in the character of the posters advertising the national collections of Great Britain exhibited by the London Transport Board, and those shown here by the United States Museums, which consist of carefully devised and prepared propaganda material. The same difference is to be noted in the character of the two sets of publications. Whereas the English museums have prepared series of postcards and guides which offer a wealth of material bearing upon nearly every aspect of art, science and history, from which teachers are left to select for themselves, in the United States the museums, undertaking the direct educational function, circulate among the schools illustrative material selected by their own education departments, but rely mainly on the organized work and lectures of their own educational staffs, for which special accommodation is provided in the museum building.

Human Problems of Management

IN an address at the Commencement Exercises, Massachusetts Institute of Technology, on June 6, Sir Harold Hartley pointed out that, apart from new inventions and discoveries, the great changes in industry in this century have been largely in the direction of transforming traditional methods depending on the personal skill of the operator to scientifically controlled processes in which measurement has largely taken the place of craftsmanship. A new standard of certainty based on scientific measurement has invaded every branch of industry and engineering. The human problems of management, however, are equally important and are much more difficult than the selection and working of inanimate material. Success or failure may depend on the wise choice of men, in which there is no figure of merit as guide. There are also the wider human problems of industry and the collective life of the factory; the emotional response of the individual, the human understanding of the supervisor may influence efficiency and output as much as scientific planning. These human problems of management, Sir Harold said, become increasingly important with the size of the concern, and the rapid growth of the great corporations constitutes a new factor in our social organization, so that any danger of their inability to utilize human effort to the best advantage is an urgent problem. When an organization becomes too large for personal leadership, it is in danger of losing its character and vitality, of becoming mechanical, with all the loss of efficiency implied thereby in a human agency.

ORGANIZATION, however, implies not only order in the distribution and co-ordination of the functions of the separate parts, but freedom for the individuals within their sphere of action. The remedy for the dangers of specialists through their ignorance outside their limited sphere of knowledge is a synthesis, which is the object of a large industrial undertaking in securing the co-operation of a team of specialists. Its smooth running depends on the ability of each of its component groups to engage intelligently in its particular task in proper co-ordination with the rest. Sir Harold Hartley does not believe that individual initiative disappears with increasing size. Without initiative there cannot be the steady flow of ideas, not merely outwards from the centre but inwards from each section, which is essential for success. The key problem is that of supplying adequate motive power in place of the self-interest motive, which must largely disappear. Accordingly, he stressed the importance of the study of incentives based on personal satisfaction, the development of the team spirit, and of the value of recognition in sweeping away negative inhibitions which hinder the possibility of achievement. It is the business of a leader to find the opportunities for success and to see that everyone is made to feel his part in them and to know that his part is recognized.

Pre-Roman Archæology in Shropshire

IN view of recent developments in the study of British archæology and prehistory in the period preceding the Roman invasion, considerable interest is attached to the announcement that the earthworks which crown the slopes of the Wrekin in Shropshire are to be excavated by the Society of Antiquaries of London in co-operation with the Shropshire Archæological Society. It is thought probable that the Wrekin was the headquarters of the tribe of the Cornovii before they were removed by the Romans to the riverside site of Viroconium or Uriconium, the modern Wroxeter, some time about A.D. 60–70, much as the tribesmen were removed from Maiden Castle to Dorchester in the same period. Uriconium itself, the Roman site, has recently been excavated by Miss Kathleen Kenyon, and it is now the opinion of archæologists that the time has come to investigate the earlier site. It will be a matter of interest to see whether the suggestion thrown out by Dr. R. E. Mortimer Wheeler of an indication in his recent excavations in southern Brittany pointing in the direction of Shropshire is in any way borne out by the results of the investigation now contemplated.

Permission for the work has been given by Lord Barnard, the owner, and the work will be under the direction of Miss Kenyon. Excavation will begin in the current year, and it is hoped will be completed in 1940. A committee has been appointed for the purpose of raising funds to meet the cost of excavation, of which Mr. A. W. Clapham, president of the Society of Antiquaries, is chairman, with Sir Charles Marston and Sir Frederic Kenyon as vice-chairmen, while among the members of the committee are Lord Harlech, Lord Powis, Lord Baldwin, Sir Charles Peers, Dr. R. E. Mortimer Wheeler and Mr. J. P. Bushe-Fox. Contributions to the excavation fund may be sent to the Assistant Secretary, Society of Antiquaries, Burlington House, Piccadilly, London, W.1.

Imperial Studies in Chinese Archæology

OWING to the preoccupation of Chinese antiquarians with literary rather than material evidence, an exceptional interest attaches to an imperial scroll now on exhibition in London, which was painted in A.D. 1729 by command of the Emperor Yung Chen. The scroll is of paper, measuring 49 feet long by 24½ inches wide, and forms an illustrated record in colour of some of the personal possessions of the Emperor, including objects in bronze, jade, ivory, pottery and porcelain. More than two hundred objects are represented. To the student of Chinese archæology and the development of Chinese art, the interest of this early catalogue lies in the fact that the objects range in date from the early Chou dynasty, about the close of the second millennium B.C., down to porcelains of the early eighteenth century of our era. It is, in fact, a contemporary manuscript catalogue, illustrated by hand, of a remarkable collection of antiquities, which are shown as a continuous band of colour plates. At the time the scroll was painted, the Emperor, who died in 1735, was engaged in preparing the plans for his tomb; and it was from this tomb that the scroll was obtained by a British officer at the time of the Boxer Rebellion. It is now on view at the galleries of Messrs. Spink and Son, 5-7 King Street, St. James's, in aid of the Maternity Ward of the Royal Northern Hospital, London. As no scroll of this type has previously been exhibited in Europe, it has been displayed at full length on the walls of the exhibition hall and is accompanied by a key, in which the various objects have been drawn in outline with notes by experts on their type and ceremonial use. In view of the wide range in character and date of the objects depicted, the value of the scroll thus elucidated for archæological and æsthetic studies is obviously considerable.

The History of Cement

THE summer meeting of the Newcomen Society was held in Suffolk on June 7–10 with Ipswich as the headquarters. The itinerary included visits to the bell cage at East Bergholt, weaving factories at Sudbury and Hadleigh, the post mill at Saxstead, the tide mill and steelyard at Woodbridge and the works of Ransome's, Sims and Jefferies, Ltd. After the annual dinner on June 8 three papers were read, one of them being by Dr. A. P. Thurston on "Parker's 'Roman' Cement". In 1796, James Parker, of whom little is known, took out a patent for "Cement or Terras to be used in Aquatic and other Buildings and Stucco Work". This cement was made by burning in kilns the hard stone-like concretions called septaria, found around the coasts of Essex and Kent wherever the London clay bordered the shore and formed low cliffs. Previously this material had been used for building, but when the making of Parker's cement began there was a great demand for it, and the practice grew up of dredging it from the bottom of the sea off Walton-on-Naze and elsewhere. In 1857 there were between three and four hundred smacks engaged in this dredging. The principal factories for cement manufacture were at Harwich, and at one of these 'Roman' cement was made until 1890. Joseph Aspdin's patent for 'Portland' cement was taken out in 1824, but it was the improvements effected in its manufacture by I. C. Johnson at Swanscombe which led to 'Portland' cement superseding 'Roman' cement. Dr. Thurston's paper was accompanied by a bibliography of the subject.

New B.B.C. Stations

ON June 14, the revised West Regional Scheme of the British Broadcasting Corporation was brought into operation by the opening of the new transmitting stations at Start Point and Clevedon. These stations now radiate simultaneously the West Regional programme on wave-lengths of 285·7 and 203·5 metres respectively. The Start Point station is situated near the most southerly point of Devon, and is intended to serve the whole of the south coast from Cornwall to Hampshire or Sussex; while Clevedon on the North Somerset coast will serve the areas around Bristol, and the northerly parts of Somerset and Devon which cannot be covered satisfactorily from Start Point. Both stations have been so located as to take advantage of transmission largely over a sea path, and thus avoid the heavy attenuation of signal strength encountered in wave propagation over the poorly conducting terrain of Dartmoor.

SOME technical details of the Start Point station were given in the *Wireless World* of June 15, from which it is learned that the new station is at present using a power of 100 kw., which will ultimately be raised to 150 kw. In order to give the greatest service along the south coast, the aerial system has been designed to give its maximum radiation in the east and west direction, with a minimum, but by no means negligible, radiation in a southerly direction over the English Channel. This directional radiation has been secured by the use of two steel mast-radiators, 450 ft. high, spaced about three eighths of a wave-length apart. Both mast aerials are connected to the transmitter, one directly and the other through a suitable phase-shifting network. This network has been carefully adjusted during the initial test-period to give the desired distribution of signal radiation.

The carrier-wave frequency is controlled to an accuracy of better than one part in a million by a high-precision quartz crystal, and the modulation arrangements of the transmitter have been designed to give a very high programme quality.

Infestation of Grain by Insects

A SURVEY of the conditions of infestation in the grain trade in Great Britain was initiated about a year ago (NATURE, June 4, 1938, p. 1004), as a result of which it appeared that research into control and remedial measures against pest infestation of all stored produce was desirable. At the request of a Standing Conference representing the industrial interests co-operating in the work, the Department of Scientific and Industrial Research has agreed to undertake this research and an advisory service for industry. The work will be carried out with the technical and financial co-operation of industry, by the Imperial College of Science and Technology at the Biological Field Station of the College, at Slough, under the direction of Prof. J. W. Munro, professor of zoology and applied entomology at the College, to whom inquiries relating to this new service should be sent. Industrial organizations interested in the work should communicate with W. McAuley Gracie, chairman of the Standing Conference on Pest Infestation, Department of Scientific and Industrial Research, 16 Old Queen Street, London, S.W.1.

National Parks

THE winter number of the *Tree Lover* (3, No. 26, De la More Press, 2*a* Cork Street, London, W.1) includes an article on the case for national parks, which deals with the report of the Standing Committee on National Parks. In discussing this important question, many fall into the mistake of comparing Great Britain with Canada, the United States and other countries of the New and Old World of much larger size and with extensive tracts of wild, undeveloped countryside where great national parks or game reserves have been formed. These enthusiasts are apt to forget that Great Britain is, compared with such countries, a very small and densely populated island. This being said, the case for such national parks as are, or may be, feasible is a very strong one. As pointed out in the article in question, such a movement "falls in most signally with the aims of the Health Campaign on which the Government is at present engaged. If abundance of Playing Fields is essential for this, still more essential is the provision, or preservation, of national 'walking grounds', and regions where young and old alike can find refreshment and inspiration in the enjoyment of unspoilt Nature". The proposals of the Standing Committee on National Parks are well known. The chief question in connexion with these proposals is where the money is to come from. The suggestion is the Treasury. There is also a considerable body of influential opinion which considers that this question is one for the general public. That in fact if the public really want the national parks a fund should be opened to provide the money for their formation and upkeep; that the British public will attach a greater value to, and have a greater interest in, the maintenance of national parks provided by their own endeavour than if they are more or less controlled by the Government and therefore nobody's child.

Meteorology for Airmen in India

A PAMPHLET of the India Meteorological Department, having the title "Meteorological Organisation for Airmen", brings up to date the information required by airmen in India who wish to take advantage of available information about actual and expected weather on the various aviation routes in that country. There are several classes of meteorological station in the organization that is concerned with meeting the demands of aviation, of which the most important are the forecasting centres where synoptic weather charts are prepared twice a day, namely, for civil aviation (Karachi, Calcutta and Poona), and for military aviation (Karachi and Peshawar). The India Meteorological Department is responsible for the aviation weather service on the trans-India route from the Gulf of Oman to Akyab, as well as along other internal air routes in India. The positions of the four types of meteorological station more directly concerned with the supply of information—the civil and military forecasting centres, the pilot balloon stations where the winds aloft are measured, and the aeronautical wireless stations—are clearly shown on a folding map. The codes for transmitting information about the weather have become more numerous in the course of years, in proportion as the information required has become more detailed and precise, and practically the whole of this pamphlet is taken up with them. Attention is directed in a foreword to a change instituted on July 1, 1937, which resulted from the establishment of an independent meteorological service in Burma. From that date the Calcutta Meteorological Office ceased to issue weather reports and forecasts for air routes in Burma and the 'general inference' for the Rangoon–Bangkok section, these being taken over by the Meteorological Office at Rangoon, but it has continued to issue reports and forecasts for the Calcutta–Akyab route.

"Earning whilst Learning" in American Universities

THE economic depression in the United States compelled university administrators and students to devise fresh plans for enabling poor undergraduates to pay their way. The Federal Government decided to help, not with scholarship grants but by financing work projects through the National Youth Administration. So new ways were discovered for using student labour and some proved so beneficial to all concerned that they became permanent. A summary of the more important is given in *Bulletin* No. 9 of the Office of Education (Supt. of Documents, Washington, D.C., 10 cents). This gives particulars of factories, printing-presses and other money-earning projects, of co-operative housing and other schemes for reducing students' living costs, and of the 'self-help' colleges which aim at making education as

nearly as possible self-supporting. These are described as strongly Christian in intent and influence, proclaiming the dignity of labour and the fundamental importance of training in heart and hand as well as head. Yale's bursary employment scheme, providing employment for more than four hundred of the residents in its new undergraduate hostels, is described in some detail. It is so popular that well-to-do students have applied for bursary work without stipend because of the opportunities it offers for personal development. Harvard also has lately introduced an employment scheme in connexion with its new dormitories. The report emphasizes the increasing recognition of the value of money-earning labour as a part of education, especially its contribution to character-building, and the advantages of co-operative living arrangements.

The Temporary Ley

THE Welsh Plant Breeding Station, Aberystwyth, has just issued a bulletin entitled "The Temporary Ley", price 7*s*. 6*d*. It is divided into four sections. The first compares the results obtained with station-bred and commercial grasses when used in simple mixtures. Although in the first year the commercial seeds gave the best yields, distinct advantages were shown by the station-bred varieties in the third year. Relative aggressiveness of the different species in a mixture is also an important point; timothy, for example, failing to become established when sown in conjunction with cocksfoot or perennial rye grass. Section 2 deals with the yield and persistency of different strains of grass and clover. Mixtures containing indigenous species gave both higher yields and better response to phosphatic manuring than those in which such species were in the minority or lacking. Pasture management and its effect on the sward is the subject of the third section. Swards differing widely in botanical composition were subjected to various systems of management, and it was found that the importance of a species is determined by the individual reaction of the plant to the type of management, as well as its ability to withstand competition from other components of the sward under those conditions. The final section consists of an article by Sir R. George Stapledon, director of the Station, on the establishment and maintenance of temporary leys. This will perhaps be of particular value to the agriculturist as it deals largely with the practical aspect of the question. Final emphasis is laid on the fact that success depends on the combination of a well thought-out seeds mixture with good management.

A Pioneer Garden Journalist

A SHORT chapter of garden history in the early eighteenth century is unfolded by Mr. W. Roberts, in a paper on Richard Bradley, F.R.S. (*J. Roy. Hort. Soc.*, 64, Pt. 4; April 1939). Bradley was the first professor of botany at Cambridge, and though he does not appear to have conferred much sound teaching upon his students, nor given academic dignity to the University, he was responsible for a series of volumes which exerted considerable influence upon horticulture at that period. "A General Treatise of Husbandry and Gardening" was one of his greatest contributions, and forms the main subject of Mr. Roberts's paper. The text introduces "Such Observations and Experiments as are New and Useful for the Improvement of Land", and, indeed, Bradley's experiments represented his major contribution to horticulture, at a period when it was the fashion only to copy and quote. He states that his expenses in the study of the nature of plants and soils cost him upwards of £2,000, and he also travelled widely. Though his undertaking to establish a Botanical Garden at Cambridge did not flourish greatly, he distributed much garden knowledge of an exact order.

Earthing with Driven Copper Electrodes

A HUNDRED years ago, when electricity was usually generated by the use of frictional or Wimshurst machines and detected by gold leaf electroscopes, it was well known that an electric charge on a conducting surface could be dissipated by connecting the charged surface to earth. It is now found that owing to the increasing electric power behind modern networks, in order to get safe operation special attention has to be paid to the conductor connecting charged metallic objects to earth. Copper electrodes of small diameter cannot be driven with a sledge-hammer unless the ground be soft, as the rod will bend or the top will be deformed. The Copper Development Association of Thames House, Milbank, London, S.W.1, has published a booklet entitled "Copper for Earthing" which gives several useful hints on this problem. The most satisfactory method of driving copper electrodes into the earth is by means of an electric hammer which delivers a large number of light blows. The usual procedure is to choose the wettest or the most low-lying spot in the neighbourhood and drive a copper rod of small diameter into the earth to a depth of about eight feet. The earth resistance is then measured; if too high, several more rods can be driven in and connected in parallel. This is necessary for earthing mains where a possible fault current may be very large. The booklet points out that, even now, earth connexions are sometimes made by a few feet of conduit buried outside the house or under the floor in contact with a small iron plate or with the hot-water piping system. Sometimes even a large electric machine is earthed by binding the wire round a loose rock lying on the ground. In one case the earthing wire was found to terminate in a bottle of water!

London's Water in 1937

THE results of the chemical and bacteriological examination of the London waters for the twelve months ended December 31, 1937, are contained in the thirty-second annual report of the Metropolitan Water Board, recently issued (P. S. King and Son, Ltd., 14 Great Smith Street, Westminster. 10*s*. 6*d*.). Much of the report was drafted by the late director, Col. Harold, before his death last July, and the task

of completing it has fallen upon the deputy director, Mr. Denison Byles. The total average output from the works for the year was 310·79 million gallons per day. Of 22,000 routine samples examined bacteriologically, about 98 per cent were of first-class purity (absence of *Bact. coli* in 100 c.c.). Details are given of several researches carried out in the laboratories. In the Bacteriological Section, various methods for the isolation and identification of *Bact. coli* have been tested and compared. In the Biological Section, investigations into the algal flora of raw and stored waters have been continued. In the Chemical Section, a further account is given of the use of a new photo-electric turbidimeter. The chief analytical results for each month in the year of the several sources of supply are given in a series of tables.

The Brotherton Collection

THE third annual report of the Brotherton Collection Committee, University of Leeds, states that a beginning has been made in the work of valuing the Collection, case by case, and of cataloguing the uncatalogued books (University of Leeds: The Brotherton Collection. Pp. 4. Leeds: The University, 1938). A scheme has been drawn up for the purchase of new books, which would be confined to certain authors and subjects wherein the Collection is already strong, so that relative completeness could be obtained. The very extensive collection of pamphlets on Sheffield has been re-arranged. Mr. J. A. Symington, first keeper of the Brotherton Collection, relinquished that office on July 31, 1938, and on the recommendation of the Brotherton Collection Committee, the Council of the University of Leeds appointed Dr. Richard Offor, the University Librarian, to be Keeper of the Collection from August 1.

The Earthquake of May 10, 1939

FROM instrumental reports from Fordham, Georgetown, St. Louis, Victoria, Honolulu, Manila, Pasadena, Philadelphia, Chicago and Burlington, the U.S. Coast and Geodetic Survey has determined the epicentre of the earthquake of May 10 at 7h. 44·4m. G.C.T. to be provisionally lat. 51° N., long. 179° W. This is to the south of the Andreanof Islands, which form part of the Aleutian Islands, and is on the circum-pacific ring of instability somewhat to the west of the epicentre of the great earthquake of November 10, 1938.

Conference on Photography

THE Manchester and District Branch of the Institute of Physics has arranged a Conference on Photography, to be held in the Physics Department, University of Manchester, on July 3 and 4, under the chairmanship of Dr. F. C. Toy. Among those taking part are Prof. N. F. Mott, Dr. J. C. M. Brentano, Dr. W. F. Berg, Dr. D. A. Spencer, Dr. S. O. Rawling, E. R. Davies, C. W. Bradley, Dr. J. G. Wilson, Dr. C. A. Adams and Dr. H. A. Bruck. The subjects to be discussed include the atomic physics of photography, colour photography, theories of developers, and applications of photography in research. Further particulars can be obtained from Dr. W. H. Taylor, Physics Department, College of Technology, Manchester, 1.

Marine Biological Association

AT the annual general meeting of the Marine Biological Association of the United Kingdom, Dr. George Parker Bidder was elected president of the Association in succession to Lord Moyne, who had held office for the past nine years. Lord Moyne, Lord Mildmay of Flete, and Sir Reginald Dorman-Smith were added to the list of vice-presidents. Mr. H. C. Maurice, Lord Rothschild, Mr. J. R. Norman and Mr. Morley Neale were elected new members of council.

Announcements

LIEUT.-COLONEL J. H. M. GREENLY has agreed to continue as president of the Institute of Fuel for a further year, and will deliver his second presidential address on October 19. The Council of the Institute has awarded the Melchett Medal for 1939 to H. A. Humphrey, late consulting engineer to Imperial Chemical Industries, Ltd., for the outstanding work he has done in the development of fuel and appliances in connexion therewith.

MARC TIFFENEAU, professor of pharmacology and materia medica in the Faculty of Medicine, University of Paris, has been elected a member of the Section of Chemistry of the Paris Academy of Sciences, in succession to the late Prof. G. Urbain.

THE German Chancellor has awarded the Goethe Medal for Arts and Science to Prof. Ernst Rudin, professor of psychiatry in the University of Munich, for his work on German racial hygiene.

THE annual meeting of subscribers and friends of the Rothamsted Experimental Station, Harpenden, will be held on June 28, when the principal speaker will be Sir E. Kaye Le Fleming, chairman of council of the British Medical Association.

FOLLOWING the nineteenth annual general meeting of the British Non-Ferrous Metals Research Association on June 29, the Association's new laboratories in Euston Street, London, N.W.1, will be formally opened by the Right Hon. Oliver Stanley, president of the Board of Trade, and a memorial to Thomas Bolton will be unveiled.

THE *Internationale Zeitschrift für Psychoanalyse und Imago*, which was temporarily suspended, resumed publication in March 1939. The present address is 96 Gloucester Place, W.1, and the price 34 shillings.

ACCORDING to the figures issued by the Metropolitan Life Insurance Company, the average duration of life for men in the United States in 1936 was 60·81 years, or 1 year and 3 months longer than in 1930.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1071.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Multiple Activities of Anhydro-oxy-progesterone

THE introduction of anhydro-oxy-progesterone (pregneninolone, ethinyl-testosterone) by Inhoffen and Hohlweg[1] and Ruzicka, Hofmann and Meldahl[2], and the demonstration by the former authors of its high progesterone-like activity when given by mouth, opens up the possibility of an important advance in endocrine therapy (see, for example, Zondek and Rozin[3]); but its multiple biological properties also make the substance of considerable theoretical interest.

In our experience, anhydro-oxy-progesterone, tested as described by McPhail[4], is equally active by mouth and by injection in producing progestational proliferation in rabbits. A total of 5 mgm. in propylene glycol produced the same average response, when given by either route, equal to that given by about 0·5 mgm. of progesterone injected in oil solution. In addition to this strictly progesterone-like activity, the compound, unlike progesterone, will cause growth of the uterus of the immature or ovariectomized rat or mouse without previous treatment with œstrone, that is, it shows metrotrophic activity similar to that of œstrone or testosterone. Thus, injection to the spayed rat causes a mixed œstrone-like and progesterone-like effect. The capacity to produce an increase in uterine weight is about the same whether the substance is given orally or by injection, but there is evidence that oral administration results in progestational proliferation of the endometrium less complicated by œstrous changes than does injection.

In addition to the rather generalized gynæcogenic property of causing growth of the uterus of the immature or ovariectomized animal, anhydro-oxy-progesterone also seems to be œstrogenic in the strict sense that it will cause cornification of the vaginal epithelium of the ovariectomized rat or mouse. Fully cornified vaginal smears were produced by the injection of 2–4 mgm. to spayed rats, and 0·8 mgm. to spayed mice. When the substance is given orally, however, its activity on the vagina is lower, since 4 mgm. produced only a little cornification in the presence of leucocytes in some rats, while 1·6 mgm. did not cornify the vagina of the mouse. Vaginal opening in the rat was also less frequent in animals receiving oral doses than in those receiving equal amounts by injection.

In the capon comb-growth test, anhydro-oxy-progesterone shows weak androgenic activity. Tested on groups of five Brown Leghorn capons, 30 mgm. by mouth produced an average increase in length plus height of 3·5 mm.; 30 mgm. by injection produced an increase of 4·6 mm., equal to that produced by about 0·5 mgm. (5 I.U.) of androsterone. By inunction on to the comb, 0·15 mgm. produced an average increase of 2·2 mm.

Of the activities of anhydro-oxy-progesterone investigated, therefore, only its effects on the rodent vagina appear to be less when the substance is given orally than when it is given by injection. In addition to this remarkable activity by mouth, anhydro-oxy-progesterone seems to be the only compound so far described which possesses progesterone-like, metrotrophic, androgenic and œstrogenic properties.

C. W. EMMENS.
A. S. PARKES.

National Institute for Medical Research,
London, N.W.3.
June 2.

[1] Inhoffen, H. H., and Hohlweg, W., *Naturwiss.*, **26**, 96 (1938).
[2] Ruzicka, L., Hofmann, K., and Meldahl, H. F., *Helv. chim. Acta*, **21**, 372 (1938).
[3] Zondek, B., and Rozin, S., *Lancet*, i, 504, No. 9 (1939).
[4] McPhail, M. K., *J. Physiol.*, **82**, 145 (1934).

Nicotinic Acid Requirements of Insects: a Biological Test for Nicotinic Acid

THE importance of vitamin B for the growth and development of insects has been stressed by several investigators. But very little is known of the ingredients of the vitamin B complex which are actually required by the insects.

We have found that the moth *Galleria melonella* can be cultivated on a medium containing one part of yeast and two parts of wax. It was noted that purification of the wax and autoclaving of the yeast in a strongly alkaline solution at 130° during a lapse of time which is sufficient to destroy both the vitamins B_1 and B_2 (riboflavin) does not impair the normal development of the insect. However, its development is stopped if the autoclaved yeast is thoroughly washed with water and alcohol. Upon addition of the aqueous or alcohol yeast extract the development is resumed.

It follows from our experiments that nicotinic acid exerts the same favourable effect as the yeast extract. Nicotinic acid can thus be identified with the vitamin B-component which is indispensable for the development of *Galleria*. This does not certainly imply that vitamins B_1 and B_2 have no influence whatever[1]. Since our experiments were not carried out in sterile conditions, the possibility remains open as to the production of these vitamins by some micro-organisms. Anyway, as a matter of fact, no development did take place in the absence of nicotinic acid.

Further experiments have shown that as small a dose as 5–10 γ nicotinic acid per 100 gm. of the medium lacking vitamin was sufficient to produce the above effect. After 8–10 days there were no living larvæ left in the medium lacking nicotinic acid, whereas big, well-developed larvæ were creeping about

in the medium with the above-mentioned dose of nicotinic acid. Smaller doses (1 γ) proved insufficient and gave inconstant results.

Thus the development of the newly hatched *Galleria* larvæ can serve as a most sensitive biological test for detecting minute quantities of nicotinic acid.

D. RUBINSTEIN.
L. SHEKUN.

Department of Biophysical Chemistry,
All-Union Institute of Experimental Medicine,
Moscow. May 13.

[1] Tracy and Subbarow have recently reported the necessity of the vitamin B_1 for the development of the mosquito larvæ (*Biol. Bull.*, 75, No. 1; 1938).

Radiations from Radiomanganese

THE radiations from radiomanganese, ^{56}Mn, have been investigated by various experimenters and, as a result, it has been concluded that a γ-ray of energy 1·7 Mev. is present, together with a complex spectrum of negative electrons. This spectrum has been analysed into partial spectra with maximum energies 1·2 and 2·9 Mev. respectively.

I have made, recently, single counter absorption measurements[2] of the β-particles from this body and coincidence experiments utilizing β-γ [1] and γ-γ [3] coincidences in turn. The β-absorption measurements confirm the upper energy limit deduced by previous authors, and are consistent with a β-particle spectrum composed of the above two partial spectra in the ratio of 0·40 : 0·60.

The β-γ coincidence experiments show a correlation of all β-particles with γ-rays. In Fig. 1 are plotted, logarithmically, the β-γ coincidence rate per quantum detected by the γ-counter (curve *a*), and the β-absorption curve (*b*). The curves are closely parallel beyond an absorption thickness of 240 mgm. per sq. cm., and the former has been scaled so as to be superimposed on the latter in this region. The coincidence rates are explicable in terms of a γ-ray of 600 kev. (± 50 kev.) following the β-particles in the harder partial spectrum and a γ-ray of 2·5 Mev. following those of the softer spectrum. These coincidence experiments yield, directly, an upper limit of 1·1 Mev. for the softer β-partial spectrum.

The γ-γ coincidence experiments, on the other hand, demonstrate the successive emission of two γ-rays by some of the excited ^{56}Mn nuclei. The γ-γ coincidence rate obtained can be explained *quantitatively* by the assumption that the softer

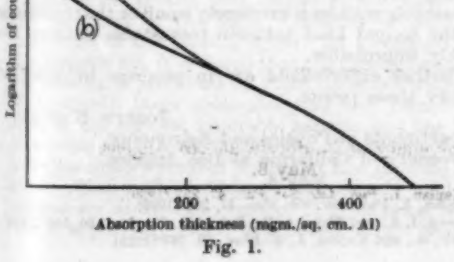


Fig. 1.

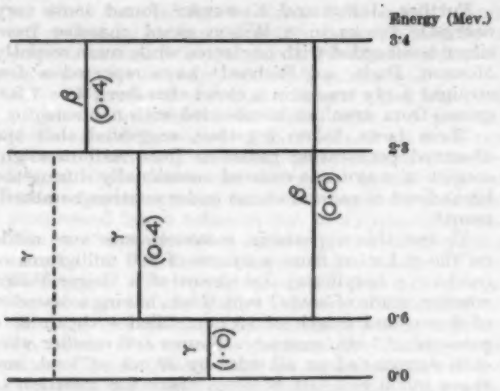


Fig. 2.

LEVEL SCHEME FOR DISINTEGRATION OF RADIOMANGANESE

Figures in brackets represent intensity of radiations per disintegration

β-particle spectrum is associated with two γ-rays of energy 1·7 Mev. and 600 kev., emitted in cascade, this assignment of energies being chosen, in preference to any other pair giving the same γ-γ coincidence rate, since the efficiency of detection of a 1·7 Mev. γ-ray together with that for a 600 kev. ray is equivalent to that for a γ-ray of 2·5 Mev.[1], and the β-γ-coincidence rate is thereby uniquely explained.

The level scheme shown in Fig. 2 is therefore obtained. It predicts a γ-ray of energy 600 kev. of 2·5 times the intensity of the harder γ-ray. The presence of this γ-ray (of 600 kev.) has been confirmed by Ward (of this Laboratory) using a pressure ionization chamber. At the same time, it has been shown that there is no appreciable intensity of the γ-ray transition shown dotted in Fig. 2.

J. V. DUNWORTH.

Cavendish Laboratory,
Cambridge. May 17.

[1] Dunworth, in the press.
[2] Feather, *Proc. Camb. Phil. Soc.*, **34**, 599–611 (1938).
[3] Feather and Dunworth, *Proc. Roy. Soc.*, A, **168**, 566–585 (1938).

Apparent Existence of a Very Penetrating Radiation from Radium and (Radium + Beryllium)

A FEW years ago, one of us[1] observed a very penetrating radiation emitted by a strong source of radium, having an absorption coefficient in lead of about $\mu = 0{\cdot}03$ cm.$^{-1}$. We have recently reinvestigated this phenomenon, as there were grounds for supposing that the radiation might consist of mesotrons. The arguments in favour of this view may be summarized as follows:

Mesotrons may be formed, according to Heitler[2], in processes such as:

$$h\nu + {}_1^1\mathrm{H} \rightleftarrows M_+ + {}_0^1n,$$
$$h\nu + {}_0^1n \rightleftarrows M_- + {}_1^1\mathrm{H},$$

provided that $h\nu$ is greater than 10^8 ev. It is now known that energies greater than 10^8 ev. are liberated during the 'fission' of heavy nuclei. The absorption coefficient of mesotrons in lead is $\mu = 0{\cdot}03$ cm.$^{-1}$, which is similar to that of the unknown radiation referred to above.

Further, Joliot and Kowarski[3] found some very energetic tracks in a Wilson cloud chamber from silver bombarded with neutrons, while more recently Mouzon, Park and Richard[4] have reported a few straight β-ray tracks in a cloud chamber (H = 1,500 gauss) from uranium bombarded with neutrons.

These facts, taken together, suggested that the observed penetrating radiation from radium might consist of mesotrons emitted occasionally during the breakdown of radium atoms under neutron bombardment[5].

To test this hypothesis, measurements were made on the radiation from a source of 900 milligrams of (radium + beryllium), by means of a Geiger-Müller counter, made of brass 1 mm. thick, having a diameter of 5 cm. and length of 15 cm., filled with air at a pressure of 7 cm. mercury. Source and counter were each surrounded on all sides by 30 cm. of lead, and space of 50 cm. left between them for insertion of absorbing screens.

A large count, about 250 impulses per minute above the background, was obtained with the 900 mgm. (radium + beryllium). When the latter source was replaced by a 600 millicurie (radon + beryllium) source (having almost the same neutron output), the same large effect was still obtained, showing clearly that the phenomenon was independent of the presence of radium atoms.

A small count was, of course, to be expected from the neutrons from the sources, but not one of this order of magnitude.

The Geiger-Müller counter was then replaced by an air ionization chamber of the same dimensions, connected to a linear amplifier, but no particles were detected having an ionization greater than about one sixth of a polonium α-particle, namely, approximately 20,000 ions.

Absorption measurements in lead gave a coefficient $\mu = 0{\cdot}03$ cm.$^{-1}$, in agreement with the earlier findings. This value is the same, however, as that found by Goldstein and Rogozinski[6] for the absorption of neutrons in lead. We therefore decided to eliminate drastically all possibility of neutrons reaching the counter by putting the source, with its lead protection, inside the 'water room' surrounding the cyclotron in the Collège de France. The water tanks are 1 m. wide and 4 m. high, and the ceiling is also covered with 50 cm. of water. Under these conditions, a count of 15 impulses per minute per curie above the background was obtained, which was surprisingly large in view of the small solid angle subtended by the counter. By emptying progressively the water tank between source and counter, the counting rate steadily increased. The maximum rate was calculated to correspond to about 1 impulse per 500 neutrons reaching the counter. Finally, the tank was refilled, and the lead protection of the counter covered with a layer of boric acid 1 cm. thick to absorb slow neutrons. When all neutrons were thus prevented from reaching the counter and its lead screens, the count from 1 curie of (radon + beryllium) diminished practically to zero.

The supposed penetrating radiation from radium and (radium + beryllium) was therefore due entirely to gamma-rays excited by neutrons in the lead protection round the counter, in the brass wall of the counter, and in the air inside it.

Grateful acknowledgments are made to the Union Minière du Haut Katanga for the loan of (radium + beryllium) sources, to the Britannia Lead Company, Ltd., for the loan of eight tons of lead ingots, to Imperial Chemical Industries, Ltd., for the loan of two tons of lead shot, to the authorities of the Radium Institute for the use of an underground room, and to the Middlesex Hospital and the Radium Institute for (radon + beryllium) sources.

M. E. NAHMIAS.

Collège de France.

F. L. HOPWOOD.

St. Bartholomew's Hospital, London.

T. E. BANKS.

W. H. RANN.

L. G. GRIMMETT.

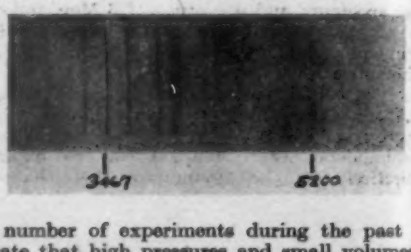
Radium Beam Therapy Research, London.

[1] Nahmias, M. E., *Proc. Camb. Phil. Soc.*, **31**, 99 (1935).
[2] Heitler, *Proc. Roy. Soc.*, **166**, 529 (1938).
[3] Joliot and Kowarski, *C.R.*, **209**, 824 (1935).
[4] Mouzon, J. C., Park, R. D., and Richard, J. A., *Phys. Rev.*, **55**, 668 (1939).
[5] Nahmias, M. E., *C.R.*, **208**, 339 (1939).
[6] Goldstein and Rogozinski, *C.R.*, **206**, 895 (1938).

Forbidden Transitions in Nitrogen

IT has been possible to observe the forbidden transition $^2D \rightarrow {}^4S$ in atomic nitrogen by a method similar to the one which led to an unusually large relative intensity of the green auroral line[1]. The essential part of the method is the weakness of the discharge which generates the afterglow.

The first such observations on the high-pressure nitrogen afterglow led to the remarkable enhancement of the $^2P \rightarrow {}^4S$ line at λ 3466·4. When the experiments were repeated, using panchromatic plates, the weaker nebular line at approximately 5200 A. appeared. No exact wave-length measurements have been made; but approximate measurements indicate clearly that the new line in the green is the expected nebular line[2]. The afterglow in which this line appeared was produced in a small quartz bulb of about 150 c.c. capacity and the pressure was about 30 mm.



A number of experiments during the past year indicate that high pressures and small volumes are favourable for the production of forbidden transitions. The absence of first-positive bands, especially those which are expected on the basis of collisions between metastable atoms and molecules of nitrogen[3], is surprising and may mean that either the number of metastable entities is extremely small or that collisions of the second kind between metastable entities are highly improbable.

Further experiments are in progress in order to clarify these points.

JOSEPH KAPLAN.

Departments of Physics and Astronomy,
University of California at Los Angeles.
May 8.

[1] Kaplan, J., *Pub. Astr. Soc. Pac.*, **47**, 257 (1935).
[2] Bowen, I. S., and Wyse, A. B., *Pub. Astr. Soc. Pac.*, **50**, 348 (1938).
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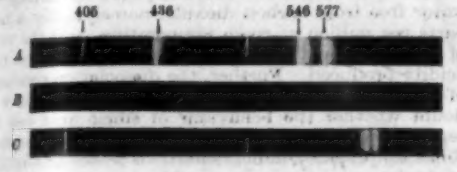
Distribution of Fluorescence Excitation of Bivalent Europium in Calcium Fluoride and of Bivalent Samarium in Calcium Sulphate

In an earlier communication[1], it was mentioned that prolonged treatment of rare earth preparations with short-wave ultra-violet radiations produces an effect similar to that obtained with radium rays.



The accompanying reproductions show the effect very distinctly. In all cases the same preparation of calcium sulphate with 10^{-3} samarium was used. The photographs were taken on material sensitized in each case for the required range. *A* shows the untreated preparation reflecting the light of the mercury vapour lamp. *B* and *C* were taken after the preparation was treated for 30 hours with light of the wave-length 240 mμ. The bands then were excited by illuminating with filtered ultra-violet. In *C* at the left of the band which extends from 689 mμ to 734 mμ also the band at 630 mμ can again be recognized as in *B*.

The mercury lines marked are those at 405, 436, 546, 577 mμ.

HERBERT P. ECKSTEIN.

Louisville, Ky.
March 27.

[1] NATURE, 142, 256 (1938).

Similarity of the X-Ray Patterns of Tanned and Mechanically Deformed Collagen Fibres

THE X-ray pattern of the collagen of animal skin has been shown[1,2] to undergo a characteristic alteration on combination of the collagen with various tanning agents. As seen in patterns produced by the ordinary technique (a mass of fibres of random orientation; unfiltered copper radiation; specimen to film distance of from two to five centimetres), this alteration consists of a remarkable diffusion of the originally sharp 'inner' ring (the side-chain spacing of 10–12 A.). The resultant diffuse halo extends clear into the central spot, and the periphery of the ring loses its original sharpness. In addition to this, the 'outer' ring (the unit backbone spacing of 2·9 A.) becomes greatly diminished in intensity, and in extreme cases disappears completely. The extent of these changes depends upon the proportion of the tanning agent combined with the collagen, the effect being more pronounced with higher tannin fixations.

It has been suggested[2,3] that they are due to a distortion of the protein grid, caused by the penetration into the grid of the large molecules or molecular complexes of the tanning agent. In agreement with this hypothesis, it is found that the greatest effect on the pattern is produced by those materials which are of relatively large molecular size and complexity, such as the natural vegetable tannins and the basic chromium salts, while substances of a simpler nature and presumably smaller molecular size produce little or no effect. Formaldehyde and certain synthetic tannins are in the latter group. An exception to this rule is apparently found in quinone, which produces an effect very similar to that of the larger tannin molecules. This may possibly be explained by a polymerization of the quinone in the alkaline solutions necessary for tannage with this substance.

We have now found that collagen which has been subjected to treatments calculated to produce mechanical deformation of the fibrils shows an X-ray pattern practically indistinguishable from that described above for tanned collagen. In carrying out these experiments, the mass of collagen fibres is first compressed into a coherent disk in a hydraulic press. This is the method we ordinarily use in preparing samples of powdered fibrous collagen for X-ray photography, and such treatment does not change the pattern in any perceptible way. Several such disks are then passed, under great pressure, between the rollers of a machine designed for rolling metal wires. The flattened disks are again reduced to the powdered state by passing through the Wiley mill, and from this powder a disk of the same weight and thickness as the original is formed in the hydraulic press. The pattern obtained from this disk, when compared on the same film with the pattern from one of the original unrolled disks, shows all the changes the characteristic features of which have been noted above. The intensity of the effect increases with additional rollings. We have also found that the same effect can be obtained merely by prolonged grinding of the collagen in the Wiley mill, where the material is subjected repeatedly to the shearing action of the knives.

These experiments have been carried out with purified collagen prepared from ox skin, and also with the tendon Achilles of the ox. Further details will be published elsewhere.

JOHN H. HIGHBERGER.
Department of Leather Research,
Institute of Scientific Research,
HAROLD J. KERSTEN.
Department of Physics,
University of Cincinnati.
April 21.

[1] Jordan Lloyd, D., *J. Int. Soc. Leather Trades Chemists*, **19**, 345 (1935).
[2] Highberger, J. H., and Kersten, H. J., *J. Amer. Leather Chem. Assoc.*, **33**, 16, 289 (1938).
[3] Jordan Lloyd, D., *J. Int. Soc. Leather Trades Chemists*, **22**, 558 (1938).

Magnetism and Polymerization

THE graphs below refer to results we have obtained for the magnetic susceptibility of dimethylbutadiene at the commencement of polymerization. Fig. 1 is for the mass susceptibilities of samples of dimethylbutadiene distilled and sealed in nitrogen, and polymerized in the dark by heat at a temperature of 140° C. Fig. 2 is for a similar treatment of

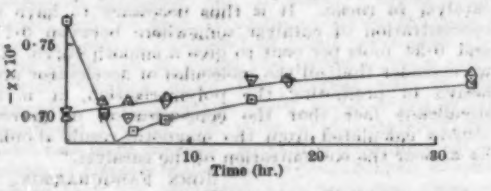


Fig. 1.

–□– Dimethylbutadiene sealed in nitrogen.
–▽– ,, ,, + 1% benzoyl peroxide.
–△– ,, ,, + 2% benzoyl peroxide.

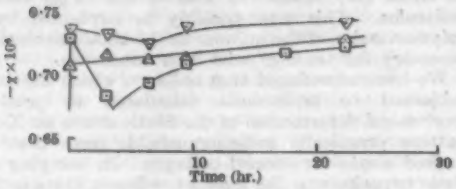


Fig. 2.

–□– Dimethylbutadiene sealed *in vacuo*.
– ▽ – " + 0·5% benzoyl peroxide.
–△– " + 1·0% benzoyl peroxide.

dimethylbutadiene distilled and sealed *in vacuo*. It will be noticed that in the absence of catalyst there is a fall in diamagnetism over the first three hours and that thereafter there is a progressive rise in diamagnetism as is to be expected[1].

We consider that measurements of this type will throw light on the nature of the induction period in polymerization reactions. Induction periods have been identified with the time of formation of polymerization nuclei; thereafter the polymerization proceeds as a chain reaction[2]. It is probable that the polymerization nuclei are activated molecules, and the simplest assumption to make is that they are free radicals. This would explain our magnetic result, as such free radicals would necessarily be paramagnetic, and their formation in the dimethylbutadiene would result in a fall in diamagnetism.

If the first series of results be examined further, it will be noticed that the initial fall in diamagnetism is in the neighbourhood of 13·6 per cent. It is possible to calculate the concentration of free radicals which would give this lowering if the assumption be made that the free radicals are of the type of dimethylbutadiene with one free electron. The mass susceptibility of dimethylbutadiene by this series of measurements is approximately $-0{\cdot}75 \times 10^{-6}$. In a paramagnetic molecule with one free electron[3], the paramagnetic contribution to the molecular susceptibility is theoretically 1270×10^{-6}. The diamagnetic contribution in this case is $-61{\cdot}5 \times 10^{-6}$. The mass susceptibility of such a molecule will thus be $0{\cdot}133 \times 10^{-6}$. The concentration of free radicals of this type necessary to lower the mass susceptibility of dimethylbutadiene by 13·6 per cent can now be calculated to be 0·10 mols per cent.

If the concentration of catalyst necessary to give a smooth curve be now considered, it is evident that this must be less than 1·0 per cent by weight, or, if the results for the material sealed *in vacuo* be considered, it lies somewhere between 0·5 and 1·0 per cent by weight, for there still seems to be a lowering of diamagnetic susceptibility with 0·5 per cent catalyst *in vacuo*. It is thus necessary to have a concentration of catalyst somewhere between 0·17 and 0·34 mols per cent to give a smooth curve. If we consider that all the molecules of accelerator are active in promoting the polymerization, it is a significant fact that the concentration of active centres calculated from the magnetic result should lie so near the concentration of the catalyst.

JOHN FARQUHARSON.
University College, P. ADY.
Rangoon.

[1] Farquharson, *Trans. Faraday Soc.*, **32**, 219 (1936).
[2] Dostal and Mark, *Trans. Faraday Soc.*, **33**, 350 (1933).
[3] Stoner, "Magnetism and Matter", 477.

'Acidity' of Quartz

WHEN quartz powder, obtained by finely grinding pure Brazilian pebble, is put into neutral water the *p*H is rapidly lowered to about 6·4. This acidity has been attributed to silicic acid, but such an explanation seems unlikely for the following reasons.

Pure quartz has an extremely low solubility in water free from carbon dioxide, namely, only a few parts per million at room temperature, and the rate of solution would not be great enough to cause the acidity produced. Further, the dissociation constant of silicic acid[1] is very small (about 10^{-10}) and there is doubt whether the behaviour of silicic acid can be represented in terms of dissociation constants[2]. Silica sol prepared under conditions where adsorption of hydrogen ions is impossible is quite neutral[3]. Hence the acidity rapidly imparted to water by quartz dust is probably not due to silicic acid, and it is suggested that carbon dioxide adsorbed on the quartz is responsible for the effect.

Samples of the quartz dust were heated to about 300° C. *in vacuo* until the evolution of gas ceased. After cooling *in vacuo*, these samples were quite without effect on the *p*H of neutral water. An approximate computation showed that the quantity of gas evolved (all of which may not have been carbon dioxide) was ample to account for the observed acidity. The addition of pure sodium chloride (itself quite neutral in water) increased the acidity of the quartz dust – water system. This is also consistent with the view that the acidity is due to carbon dioxide, for the presence of sodium ions lowers the bicarbonate ion concentration, thus increasing the fraction of the dissolved carbon dioxide that is present as carbonic acid, with a consequent increase in the hydrogen ion concentration.

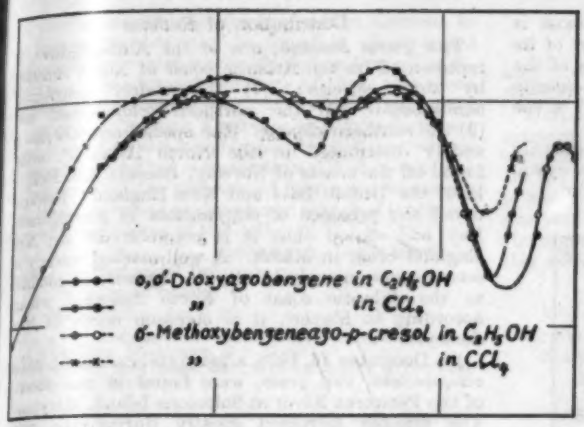
G. VAN PRAAGH.

Christ's Hospital,
Horsham.
June 1.

[1] Joseph and Oakley, *J. Chem. Soc.*, **127**, 2814 (1925).
[2] Britton, *J. Chem. Soc.*, **129**, 425 (1927).
[3] Balbaiev and Kargin, *Acta Physiochem. U.S.S.R.*, **3**, 97 (1935).

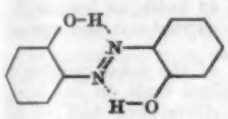
Chelate Structure of *o,o'*-Dioxyazobenzene in Solution

THE idea that the *o*-oxyazo compounds have the chelate structure is now quite convincing. It is supported by much chemical and physical evidence, such as the slight acidity, anomalous chemical reactivities referred to phenolic hydroxyl, small association factor, slight solubility in polar solvents, molecular refraction data, absorption spectra, etc. The strongest support for the chelate structure was found by Hendricks and others[1] in the study of infra-red absorption spectra in carbon tetrachloride solution. On similar grounds they concluded from the absence of the absorption band at *c.* 1·4μ corresponding to the first overtone of hydroxyl vibration that *o,o'*-dioxyazobenzene has the doubly chelated *trans-trans* configuration as (I). From the chelation of both the hydroxyl groups in (I), it may be expected that the *o,o'*-dioxyazobenzene, like the *o*-monooxyazo compounds, is very slightly acidic. But the former is actually found to be very easily soluble in weak alkali. It may therefore be supposed that the chelate structure of the *o,o'*-dioxyazobenzene is

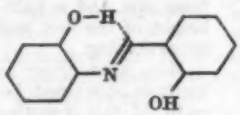


somewhat different in character from that of the *o*-mono-oxyazo compounds.

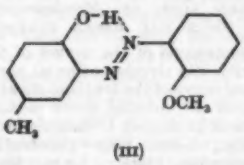
Comparison of the absorption spectra of *o,o'*-dioxyazobenzene and the mono-methyl ether of its homologue has now shown, as seen in the accompanying graph, that both substances in *alcohol* give almost the same absorption curve in the whole measured range of the visible and ultra-violet, whereas in *carbon tetrachloride* they show quite a notable difference. It has been observed[2] that the absorption spectra of substances having the inner molecular chelate ring structure such as *o*-oxyazobenzene, *o*-oxybenzaldehyde, etc., are generally affected only very slightly by polar solvents, which is now also confirmed with the *o'*-methoxybenzeneazo-*p*-cresol. The exceptional behaviour of the *o,o'*-dioxyazobenzene cannot therefore be explained otherwise than as follows: In alcoholic solution the *o,o'*-dioxyazobenzene, being stabilized through solvation by the polar solvent molecule, has the structure (II),



(I)



(II)



(III)

similar to that of the mono-methyl derivative (III), with one non-chelate phenolic hydroxyl group, which satisfactorily explains the enhanced acidity or the solubility in weak alkali. The marked displacement observed in carbon tetrachloride, especially of the first absorption band at longer wave-length ($\lambda_{max.}$ at about 400 $m\mu$), is due to the change of the structure, namely, the chelation of the second hydroxyl group in this solvent, in agreement with the conclusion of Hendricks and others[1]. On the other hand, the *o'*-methoxybenzeneazo-*p*-cresol cannot undergo such a change, so that its spectral behaviour remains normal.

In accordance with this result, the *o,o'*-dioxyazobenzene does not combine with dry ammonia in a non-polar solvent such as benzene, carbon tetrachloride, etc., which is in fact the characteristic property of the *o*-oxyazo compounds[3], whereas in a polar solvent such as alcohol, salt formation occurs very easily.

From the above spectroscopical evidence, it is concluded that the chelate structure of the *o,o'*-dioxyazobenzene is rather mobile in comparison with that of the *o*-mono-oxyazo compounds, and that it undergoes with relatively small activation energy the reversible change (I) $\rightleftarrows$ (II), which is the cause of its enhanced acidity and its marked tendency to the formation of metallic lakes.

A detailed discussion on the structure of the *o,o'*-dioxyazo compounds and their alkali salts will be published elsewhere.

HARUO SHINGU.
Kyoto Imperial University,
Kyoto. April 2.

[1] Hendricks, Wulf, Hilbert and Liddel, *J. Amer. Chem. Soc.*, **58**, 1991 (1936).
[2] Unpublished measurements.
[3] Jacobson and Hönigsberger, *Ber.*, **36**, 4105 (1903).

The So-called 'Colonial Nervous System' in Bryozoa

IT was already shown by Darwin[1] that vibracula of all the members of a Bryozoan colony are capable of synchronous movement. This and similar phenomena regarded by Müller (1860) and Hinck (1880[2]) as being due to the action of the "colonial nervous system" are now usually ascribed to a reaction of each member of the colony to a stimulus transmitted through a non-nervous route.

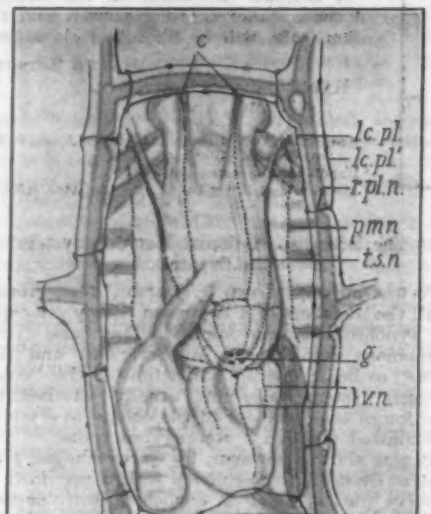
It was shown, however, by Gerwerzhagen (1913[3]) that in *Cristatella* the colonial wall is provided with a nerve plexus which is connected with nerves of tentacle sheaths of individual polypides. Gerwerzhagen regarded this plexus as a motor one. Marcus (1926[4]) considers this plexus as being both motor and sensory. Moreover, he has demonstrated experimentally the transfer of stimuli from one polypide to another both in *Cristatella* and *Fredericella*.

So far, the nerve connexions and transmissions of stimuli from one member of the colony to another have been demonstrated only for the representatives of Phylactolemmata. In Gymnolemmata, on the other hand, such nerve connexions have not yet been detected, and Marcus as well as other workers considers these organisms as being also devoid of nervous stimuli transmissions between the individual members of the colony.

While studying the nervous system in *Membranipora crustulenta* and *M. pilosa*, I found in the cystid wall of each zoœcium of these Bryozoa a nervous plexus composed of small nerve cells and long fibres. In *M. pilosa* this plexus forms a single thread winding along the internal wall of the zoœcium. This plexus sends nerve fibrils which penetrate through the pores of the anterior and posterior walls and the pores in the communication plates of the side walls into the neighbouring zoœcia, where they are connected with analogous plexuses (see accompanying drawing of zoœcium of *M. pilosa*; *r.pl.n.*, *c.p.n.*). These plexuses are connected with the nerve fibres of the tentacles which run along

their basal surface (*t.s.n.*). Thus, each plexus is connected with the central nerve ganglion (*g*) of its own polypide as well as with similar plexuses of the polypides of neighbouring zoœcia. In *M. crustulenta* the plexus forms a nerve-net in the basal wall of the cystid.

I have also found that the polypides frequently react in groups to the stimulation of the frontal cystid wall, especially in the region of the operculum.



COLONIAL NERVE PLEXUS (= SMOOTH LINE) AND A PORTION OF THE INDIVIDUAL NERVOUS SYSTEM (= DOTTED LINE) IN *Membranipora pilosa*, AS SEEN FROM THE BASAL SURFACE.

g, ganglion; *c*, connexions of the nerves of the tentacle-sheath with the circular colonial nerve plexus; *t.s.n.*, basal nerve of the tentacle-sheath; *l.c.pl.*, side trunk of the colonial nerve plexus; *lc.pl'*, a similar trunk belonging to neighbouring individual; *r.pl.n.*, nerve fibre penetrating through communication plate; *c.p.n.*, fibres penetrating through pores; *p.m.n.*, nerve of the parietal muscles; *v.n.*, visceral nerves.

I think therefore that the nerve plexus described above is responsible for the transmission of stimuli from one zoœcium to another.

The occurrence of such a system not only in Cœlenterata (Parker, 1920[5]) but also in more highly differentiated animals such as Bryozoa is a fact of general biological interest.

STANISŁAW HILLER.
Institute of Histology and Embryology,
Stefan Batory University,
Wilno,
Poland.

[2] Darwin, Ch., "Origin of Species" (6th London edition).
[3] Hinck, Th., "History of the British Marine Polyzoa" (London: J. V. Voorst, 1880).
[4] Gerwerzhagen, A., *Z. f. wiss. Zool.*, B, 107 (1913).
[5] Marcus, E., *Zool. Jhrb. Abt. f. System.*, B, 52, H. 1, 4 (1926).
[6] Parker, G. H., *J. Exper. Zoology*, 5, 31 (1920).

Distribution of *Rathkea*

THE genus *Rathkea*, one of the Anthomedusæ, is represented on the Atlantic coast of North America by three species: (1) the widely distributed *blumenbachii*, (2) the northern *octopunctata*, and (3) the southern *elegans*. The species *octopunctata* is widely distributed in the North Atlantic[1], being found off the coasts of Norway, Barents Sea, Heligoland, the British Isles and New England. Fewkes[2] noted the presence of *octopunctata* in Narragansett Bay and stated that it is common off the New England coast in March. A well-marked variety of *octopunctata*, namely, *grata*, A. Agassiz, is confined to the Atlantic coast of North America, where, according to Mayer[1], it is common north of New Jersey.

On December 16, 1938, a dozen specimens of *Rathkea octopunctata*, var. *grata*, were found in the mouth of the Patuxent River at Solomons Island, Maryland. The number increased greatly during the week following until by December 22 more than a thousand individuals were collected in a fifteen-minute plankton tow. This surface tow was taken with a No. 6 net twelve inches in diameter, and covered a linear distance of about seven hundred feet in water less than ten feet in depth. After nine days, December 25, the number of *Rathkea* began to decrease, and by December 29 only occasional specimens were observed.

An examination of the specimens of *Rathkea* collected on December 22, 24 and 29 shows several points of interest as regards certain taxonomic characters. The endoderm of the tentacle bulbs and the manubrium varied from a deep brilliant orange to a bright red in colour. The bell was more nearly dome-shaped than pyriform in many individuals. The bell measurements ranged from 1·4 mm. to 4·0 mm. in height and from 0·8 mm. to 3·7 mm. in width. The number of tentacles present in the four radial clusters varied from three to five each, while the number in the interradial clusters varied from one to three each. The marginal tentacles were from one and a half times to twice as long as the height of the bell, and were carried out and upward in swimming.

More than three fourths of the total number of medusæ examined bore medusa buds on the interradii of the manubrium. About one half of the specimens had two or three medusa buds and thirty individuals had four, one in each interradius. The medusa buds were as large as, or larger than, the manubrium of the parent medusa, and all had at least one tentacle in each of the radii. A few were noticed that possessed two tentacles in the radii.

The conditions under which this form occurred should be noted. The salinity during the latter half of December varied from 13·30 per mille to 15·45 per mille. Corresponding values for the previous month were above normal, ranging from 17·02 per mille to 17·64 per mille. Dissolved oxygen values during the period in question ranged from 7·32 to 8·27 c.c. per litre in contrast to values of 5·40 to 7·40 during November. Temperatures during the December period were characteristically low, ranging from 2·5° to 5·9° C., and represent a contrast to the high values (7·20°–14·6° C.) prevailing between November 17 and December 16. Two factors, the high salinity of November and the low temperature of December, may be of importance in explaining the presence of *Rathkea* in waters south of its normal range.

A possible explanation for the sudden decrease in numbers of *Rathkea* may be found in observations made on *Cyanea* which were collected on December 30. Analysis of the stomach contents of these specimens disclosed the presence of *R. octopunctata* var. *grata* in abundance. As high a number as eighty-four were found in one *Cyanea*, which measured 6·3 centimetres in diameter. Further stomach analysis of each of the *Cyanea* revealed the presence of numerous fragments of *Rathkea*, including medusa buds, marginal tentacles, manubria and pieces of the bell.

ROBERT A. LITTLEFORD.

Chesapeake Biological Laboratory,
Solomons Island,
Maryland. April 20.

Mayr, A. G., "Medusae of the World", Vol. 1, Carnegie Institution of Washington, Washington, D.C. (1910).
Fewkes, J., *Bull. Mus. Comp. Zool.*, Harvard College, **3**, 142, plate 1, Figs. 1–7 (1881).

Sound Absorption of Snow

I HAVE only just seen the letter of Messrs. Kaye and Evans on "Sound Absorption of Snow" in NATURE of January 14, p. 80.

During my expedition to the Jungfraujoch last summer, we had interesting evidence of the absorptive capacity of snow in a shaft which we dug in the firn. By the time this had reached a depth of about 35 ft.; it was impossible for those at the top to hear the words of the men working below, even if raised in a shout, and it became necessary to signal, even at this small depth, by means of a bell.

G. SELIGMAN.

Warren Close,
Combe Hill Road,
Kingston Hill,
Surrey.

Points from Foregoing Letters

THE biological activity of anhydro-oxy-progesterone when given by mouth has been further tested by C. W. Emmens and A. S. Parkes, who find that it has metrotrophic, androgenic and œstrogenic properties. It causes cornification of the vaginal epithelium of the ovariectomized rat or mouse and progestational proliferation of the endometrium, to a somewhat less extent than when given by injection, but is equally effective in producing an increase in the weight of the uterus.

It is stated by D. Rubinstein and L. Shekun that nicotinic acid is indispensable for the development of the moth *Galleria mellonella*. As a very small dose of nicotinic acid, that is, 5–10 γ per 100 gm. of the deavitaminated medium is required, the development of the newly hatched *Galleria* larvæ can serve as a most sensitive biological test for detecting minute quantities of nicotinic acid.

The radiations from radiomanganese, ^{56}Mn, have been investigated by J. V. Dunworth using the coincidence method. β-γ and γ-γ coincidence measurements together with single counter β-absorption measurements enable a consistent level scheme to be suggested. An additional γ-ray of 600 kev. of high intensity was predicted and its presence in the ^{56}Mn spectrum has been confirmed by A. G. Ward using a pressure ionization chamber.

In following up earlier work suggesting the emission of mesotrons from (radium + beryllium), M. E. Nahmias, F. L. Hopwood, T. E. Banks, W. H. Rann and L. G. Grimmett find that the observed effects were due to gamma-rays excited by neutrons in the lead protection of the Geiger-Müller counter.

The nebular line at 3466·4 A. in atomic nitrogen has been observed by J. Kaplan in a high-pressure afterglow in nitrogen. The unusually high relative intensity of the forbidden lines appears to be characteristic of afterglows which are generated by weak discharges. The weaker nebular line at 5200 A. appeared on panchromatic plates.

H. P. Eckstein has shown that by irradiation of rare earths with short-wave ultra-violet a result can be obtained which is comparable to the effect of radium treatment. The trivalent samarium originally present shows after irradiation the characteristic bands of divalent samarium produced by radium treatment.

J. H. Highberger and H. J. Kersten find that collagen fibres (prepared from the skin or the tendon Achilles of the ox), after they have been subjected to strong mechanical deformation by rolling or prolonged grinding in the Wiley mill, show an X-ray pattern practically indistinguishable from that obtained with tanned collagen fibres.

J. Farquharson and Miss P. Ady find from measurements of the magnetic susceptibility of dimethylbutadiene, as it polymerizes, that in the complete absence of accelerator there is an induction period during which there is a fall in diamagnetism, probably due to the formation of paramagnetic centres in the dimethylbutadiene. On calculating the concentration of such centres, it is found to be the same as the concentration of catalyst necessary to give a smooth curve.

G. Van Praagh finds that quartz dust which has been heated to 300° C. *in vacuo* does not affect the *p*H of neutral water, and suggests that the acidity usually observed is due to adsorbed carbon dioxide.

From observations on the absorption spectra in alcohol and in chloroform, Haruo Shingu concludes that the chelate structure of *o*,*o*′-dioxyazobenzene is rather mobile in comparison with that of the *o*-monooxyazo compounds. It undergoes readily a reversible change which gives it an enhanced acidity and a marked tendency to the formation of metallic lakes.

S. Hiller has demonstrated in Gymnolemmata the existence of nerve connexions and transmissions of stimuli from one member of a colony to another. This shows a more general occurrence of such a system in Bryozoa.

The presence of the northern variety of Anthomedusa *Rathkea octopunctata* as far south as the mouth of the Patuxent River, Maryland, is ascribed by R. A. Littleford to the unusual low temperature, and to the high salinity in the previous month. The medusæ decreased in number due to the predatory activities of *Cyanea*.

Research Items

Dental Caries in the Punjab, Northern India

A RECENT diet and health survey of the Kangra District, Punjab, Northern India, carried out by the Public Health Department and Dr. D. Curjel Wilson, has shown a high incidence of rickets and osteomalacia, and definite vitamin D, calcium, and phosphorus deficiencies in the diet of the population. Fifty children with rickets were examined clinically and dentally by G. F. Taylor and C. D. Marshall Day (*Brit. Med. J.*, May 6, 1939). A radiological examination of ten subjects showed that four had no caries, and in the remaining six, fourteen cavities only were found—an average of 1·4 cavities per head. In 96 temporary and 135 permanent teeth, two cavities were in the temporary, and twelve in the permanent teeth. The children came from a hill district and live in primitive conditions, the diet consisting mainly of carbohydrates, with relatively small proportions of protein and fats. Meat and fruit are almost entirely absent; and very small quantities of milk and vegetables are consumed. Sugar is rarely eaten. Two meals a day only are taken, of rice and chapattis made from home-ground flour. Rickets and osteomalacia are common. It is concluded that vitamin D deficiency alone does not cause either dental caries or hypoplasia of the teeth. The low incidence of dental caries and the excellent teeth and jaw formation are characteristic of the peasant of the Punjab, and have not been seen equalled by the authors in either Great Britain or America. An investigation of the teeth of 800 school children of the middle class in Lahore, having a diet more in keeping with European standards, including soft carbohydrates and sugar, showed an average of 6 cavities per head. The evidence appears to lend support to the 'detergent' theory of Sim Wallace, which postulates that the physical nature and cleansing action of the diet is more important than other factors in the promotion of dental caries.

Parthenogenesis in Vertebrates

A RECENT issue of the valuable series of monographs "Actualités Scientifiques et Industrielles", No. 651 (Hermann et Cie., Paris) falls into the group dealing with "Biologie et Reproduction" and has been written by the editor of the group, Jean Rostand. Parthenogenesis in invertebrate animals is well known and a usual method of multiplication in not a few species; but it is less often recognized that natural parthenogenesis of a limited kind occurs among fishes and batrachians, is in varying degrees a regular occurrence in the unfertilized ova of birds, and has long been known in mammals, both in ovarian and free ova. The phenomenon is generally confined to a rudimentary segmentation, limited in extent and, as in birds, proceeding more slowly than the segmentation which follows fertilization, although conforming with it in its general lines. The discovery of natural parthenogenesis led to the development of artificial parthenogenesis and this, particularly amongst batrachians, has led to a long series of experiments in which a wide variety of physical and chemical activators has been studied. The 62 pages of "La Parthénogenèse des Vertébrés" give a succinct account of present knowledge of both natural and artificial parthenogenesis, and point to gaps which future investigation might profitably endeavour to close. For example, no success has attended attempts to prolong the natural parthenogenesis which is normal in ova of domestic fowls, nor has anything been done here to test artificial activators. Amongst reptiles no positive evidences have yet been discovered of parthenogenesis, natural or artificial.

Cactus-feeding Moths of the Family Phyticidæ

A SMALL Argentine moth (*Cactoblastis cactorum*) of the above family has largely saved a great area in Australia from being converted into desert owing to the spread of prickly pear. Plants of this kind are common over the United States, Mexico and South America, where they are kept more or less under control by various insects and by competition with other plants. Nearly half a century ago a few prickly pear plants were introduced into Australia from North America and were intended solely for gardeners. The continent had no indigenous cacti and these few examples proved to be the progenitors of millions which ran wild. The invasion is now a matter of common knowledge, and by 1925 more than sixty million acres in Queensland were rendered useless by prickly pear. After almost every possible method of control had been considered or exploited, salvation came in the form of the inconspicuous small moth *Cactoblastis*, the larval activities of which eventually reduced the prickly pear to a state of real control, and fifteen million acres are now available for settlement and cultivation which had previously become completely useless. Various Lepidoptera have larvæ which feed upon cacti, and many of them belong to the family Phycitidæ. These have recently been classified by Carl Heinrich, senior entomologist of the U.S. Bureau of Entomology and Plant Quarantine (*Proc. Nat. Mus.*, 86, 331–413; 1939). This information is now available for Australian and other entomologists. So far as is known, it is only the species *C. cactorum* that is really effective as a controlling agent under Australian conditions. The other species caused but little effect on the plant, mainly, perhaps, because their larvæ feed scattered in an individual fashion, whereas those of *C. cactorum* feed in companies and may amount to many thousands on a single plant. Altogether there are no fewer than eighteen genera, including nearly fifty species of Phycitidæ, the larvæ of which are known to feed on prickly pear.

Fungal Rotting of *Sequoia* Timber

THE Californian redwood tree, *Sequoia gigantea*, does not appear to be a common host for parasitic organisms, but J. A. Macdonald has recently described a fungus which has rotted the wood of young trees growing in Scotland (*Ann. App. Biol.*, 24, No. 1, 83–86, Feb. 1939). Cultural and microscopical characters show that the species concerned is *Coniophora puteana*. Several species of *Coniophora* have been described as secondary parasites; but it seems clear in the present investigation that the organism is acting as a primary pathogen. The fungus can attack blocks of healthy *Sequoia* wood, and can also infect lime, maple, horse-chestnut, hornbeam, alder, oak, elm, beech, willow and birch.

Properties of Virus

Hideo Moriyama and Shunkichi Ôhashi have recently published a review of their own and other modern researches upon the physico-chemical nature of viruses (*J. Shanghai Sci. Inst.*, Sect. 4, **4**, 63, Feb. 1939). They describe a general method for the isolation of virus protein, and show that the activities of ultra-microscopic organisms are inseparable from such material. With regard to virus production in the host, it is stated that "viruses can be considered as a coagulant of protoplasm-proteid, in which some chemical change is produced by the physico-chemical influence of the virus". The problem is complicated by the fact that other minute particles of protein are known, which have no virus activity, and the paper under review considers the minute physical and chemical differences between these two similar states of protein. Immunity to virus attack is considered, and also the fascinating problems as to how viruses arise, and whether they can have separate multiplication away from living host cells. Animal viruses provide almost all the data, though plant viruses are occasionally mentioned to demonstrate similarity to their related zoological parasites. A plea is also made for a new subject of 'virology', and, indeed, the paper forms an excellent summary for teaching purposes.

Virulence of Bacteriophage

MANY different kinds of virus which attack animals and plants show considerable range of virulence. It would be reasonable to suppose that the same character would be observed for bacteriophage, a virus disease of bacteria, and there have been several investigations of this problem. Hideo Moriyama and Shunkichi Ôhashi (*J. Shanghai Sci. Inst.*, Sect. 4, **4**, 51–61, January 1939) have recently worked with a phage of *Bacillus coli*, and they find no confirmation of the statements made by earlier workers that the size of a phage plaque upon an agar plate culture of the bacteria is inversely proportional to the size of the phage particle producing it. The size of plaque is considered to be governed solely by the velocity of multiplication of the phage. Thus strains of phage which produce large plaques are more virulent than those which can only make small ones under similar conditions. The differing virulence of various strains tends to be perpetuated in subsequent culture. Lowering of virulence can, however, be induced by incubating phage with bacteria in media containing neither calcium nor magnesium salts, or in media containing citrate or oxalate radicals, and this induced change appears to be of a permanent nature.

Changes in Level of Land

THE relative vertical movement of land and sea is generally so slow a process that its detection by measurement rather than by inference is difficult. There is a considerable amount of evidence of such changes on the coasts of Europe in recent geological times. The only method, however, of detecting movement in progress is to keep a careful record of sea-level by one or more autographic and continuously acting tide gauges. H. L. P. Jolly has discussed this problem in a paper on "Supposed Land Subsidences in the South of England" (*Geographical J.*, May 1939). The Ordnance Survey tide gauges erected at Dunbar in 1913, Newlyn in 1915, and Felixstowe in 1917 provide some data. Precautions are taken to rule out any purely local subsidence or a settling of the structure carrying the gauge. The Dunbar record shows no aggregate change of mean sea-level over twenty-three years, but those at Newlyn and Felixstowe show a rise of sea-level during twenty-five and twelve years respectively. The Felixstowe record was interrupted in 1929. Mr. Jolly discusses at length the nature and value of the evidence, and notes that a gauge was established last year at King's Lynn and that another is projected on a site in the north of Scotland. The question of relative vertical movement between one part of the land surface and another will be settled when it becomes possible to carry out a new geodetic levelling of Great Britain. Comparisons between the first levelling in 1840–60 and the second in 1912–21 are vitiated by inaccuracies in the older works.

The International Temperature Scale

THE International Conference in 1927 defined the International Temperature Scale so as to conform as closely as possible with the thermodynamic scale according to measurements then available, and regarded it as capable of improvement as more accurate ones were obtained. Since that time, more accurate methods of measurement have been devised and Dr. H. T. Wensel, of the U.S. Bureau of Standards, has examined the results and has made suggestions for securing greater accuracy in the definition (*J. Res. Bur. Stand.*, April). Below 660° C. the scale was defined by the standard resistance thermometer, from 660° C. to 1,063° C. (the gold point) by the standard thermocouple and then up to about 5,000° C. by the Wien radiation formula. Dr. Wensel suggests that 630·5° C., the freezing point of antimony, should be substituted for 660° C., and that the Planck formula $I = c_1/\lambda^5 (e^{c_2/\lambda T} - 1)$ should be substituted for the Wien above 1,063° C. He considers that the most accurate values of the constants are $c_1 = 3{\cdot}732 \times 10^{-5}$, $c_2 = 1{\cdot}436$, $\lambda_m T = 2{,}892 \times 10^{-4}$ and σ of Stefan's expression for the total radiation $= 5{\cdot}70 \times 10^{-5}$, all in C.G.S. units. More accurate values of a number of auxiliary constants than were available in 1927 are also given.

Parabolic Orbit of a Comet by a Graphical Method

T. CLOSE has developed a method of finding how a preliminary orbit of a comet can be determined graphically to an accuracy of about 1′ (*J. Brit. Astro. Assoc.*, **49**, 6; April 1939). The method is similar to that described by G. F. Chambers in "A Handbook of Descriptive and Practical Astronomy", but contains numerous simplifications. It has also certain features in common with M. Davidson's method by means of a model in which three dimensional measurements are possible (see *Mon. Not. Roy. Astro. Soc.*, **90**, 5; March 1930). Close has taken Finsler's Comet as an illustration, and has obtained an orbit very close to that which was computed for an interval of 10 days. It is necessary to use a fairly large scale to be certain of four-figure accuracy. Of course parallax and light-time corrections are superfluous in the method, and those who are skilful as draughtsmen will find it possible to obtain a preliminary orbit, assuming parabolic motion, without a great mathematical equipment. The method is not suitable for finding the orbit of a minor planet.

Composition and Temperature of the Upper Atmosphere

ON May 4, in the lecture theatre of the Royal Institution in London, a joint discussion on the upper atmosphere was held by the Chemical Society, the Physical Society, and the Royal Meteorological Society. Instead of attempting to cover the whole subject, it was thought advisable to confine the discussion to topics in which the sciences represented by these societies were equally interested: chemical composition, density, and temperature. The electrical state of the upper atmosphere, the study of which is exclusively the domain of the physicist, was for example touched upon only in so far as it has a bearing on the subjects mentioned. Six speakers had been invited briefly to introduce various aspects, and after their contributions a general discussion was opened. Time permitted only a statement of experimental results; their theoretical explanation would probably be an appropriate subject for another meeting.

Prof. F. A. Paneth (Durham) reviewed recent attempts towards the direct chemical investigation of the stratosphere. This research was undertaken in order to decide to what extent the air of the stratosphere can be considered as being at rest; if it be fairly undisturbed by convective currents, then we should expect to find in the stratosphere the percentage of the lighter gases increased at the expense of the heavier ones. Two gases have been used for this comparison: the 'light' gas helium and the 'heavy' gas oxygen. (In the case of helium a special survey had first to be carried out to prove that on the surface of the earth its abundance shows no variations.) The results of the two dozen or so analyses so far made in England, Russia, Germany and the United States indicate that the helium and oxygen content is constant throughout the troposphere, and in the stratosphere up to about 20 km.; but that above this height the amount of helium is greater, and of oxygen smaller, by a few per cent. Even above 20 km. there is, however, no regular increase of this change in composition with height. The obvious conclusion is that in these layers diffusive separation of lighter and heavier gases makes itself felt, but that the atmosphere is still far from being undisturbed by turbulence.

It was mentioned that the three gases which are present in the troposphere in varying concentration, namely water vapour, radon, and ozone, lend themselves also to direct chemical investigation, and that attempts at their measurement in air samples from higher strata are in progress.

The following speaker, Prof. S. Chapman (London), pointed out that the chemical evidence obtained indicated that the conditions at heights somewhat above 20 km. seem specially to favour diffusion, because of the exceptional stability of the air at those levels. This is apparently due to an upward increase of temperature for some distance above 20 km.—a subject more fully dealt with by later speakers. It seems, however, unlikely that this diffusion process has free play at greater heights, because in this case the lightest gases, hydrogen and helium, would there entirely predominate over nitrogen and oxygen, in contradiction to the spectroscopic findings with which Prof. Chapman dealt in the main part of his address. The spectrum of the auroral light is due almost, if not entirely, to oxygen and nitrogen, and shows no trace of hydrogen or helium.

Besides revealing that the atmosphere throughout its whole content is principally a nitrogen-oxygen mixture, spectroscopic evidence has given information about the state in which these two gases are to be found. The emission spectra of the aurora and of the night-sky show bands due to molecular nitrogen; in the strongly excited auroral emission, light comes from ionized as well as neutral nitrogen molecules. Neither of the two emission spectra shows bands of molecular oxygen, but in both of them lines due to atomic oxygen are prominent. This dissociation is probably almost complete above 100 km.; lower down, molecular and atomic oxygen coexist, and also their combined form ozone. Nitrogen is more easily ionized than dissociated by sunlight; the regular presence of ions in the upper atmosphere is indicated by radio evidence. The ions present are probably molecular nitrogen N_2^+ and atomic oxygen, O^+; negative oxygen ions O^- are also likely to be formed, by attachment of electrons to neutral oxygen atoms.

The vertical distribution of ozone was discussed in more detail by Dr. G. M. B. Dobson (Oxford). It can be found either by sending up an instrument in a balloon and measuring the amount of ozone above the instrument at any height, or by making observations from the ground. The latter method can give the information wanted if the changes in the absorption of zenith light by ozone are watched while the sun is rising or setting; from the curves thus obtained the vertical distribution of ozone can be calculated in a somewhat complicated way. It is all the more gratifying that the results agree very well with measurements made by the balloon method. Over Europe the concentration of ozone increases steadily from the ground, reaches its maximum between 20 km. and 25 km., and decreases rapidly at greater heights. The details of the distribution seem to depend on the geographical position and on meteorological conditions; it is not yet clear whether over America the rate of increase of ozone is the same.

The other three set speakers dealt with the closely interrelated problems of the density and temperature of the upper atmosphere.

Dr. F. J. W. Whipple (Kew) first reviewed the results obtained by direct temperature and density measurements by means of free balloons, which in general have not gone above 25 km. although a few have reached, or slightly surpassed, 30 km. (The frequently quoted record of an attained height of 35 km. is probably untrustworthy, due to instrumental failure.) The lowest temperature ever recorded in the upper atmosphere was 182° K. at a height of 16 km. above Batavia. Such low temperatures are only found by ascents in the tropics; European ascents show in nearly every case temperatures in the stratosphere between 220° and 230° K.; in no case has any indication been found of any considerable departure from the uniformity which characterizes the stratosphere. In the lower atmosphere the density is greater in winter than in summer, but in the upper atmosphere this relation is reversed, the transition taking place at a height of 8 km.

In the second part of his address, Dr. Whipple discussed the use of air-waves for sounding the upper atmosphere. The fact that there are zones of abnormal audibility outside the 'zones of silence' suggests that the sound waves can travel through the air at a considerable height and then be deflected back to ground. The usual explanation given is that the uniform temperature of the stratosphere extends to some limiting height and that above that height temperature increases uniformly. The result of calculations of this kind is that the height of the trajectory of an air-wave is generally a little above 40 km. Sometimes, when the time of passage is exceptionally long, the computed height is considerably greater, 60 km. or more, but in such cases the results are more open to doubt. The velocities found for the waves correspond with temperatures averaging about 280° K. at 40 km., 310° K. at 45 km., and 335° K. at 50 km.

The first proof, however, that the temperature of the stratosphere beyond heights which can be reached by sounding balloons is not constant but increases considerably, was not provided by sound observations but inferred from the heights of appearance and disappearance of meteors. Prof. F. A. Lindemann (Oxford) explained this evidence, which was found by him and Dr. Dobson as early as 1922. The meteor phenomena can only be accounted for by the assumption that the density of air at heights around 100 km. is about a thousand times as great as the hypothesis of a constant temperature from the bottom of the stratosphere upwards would lead us to expect, and so the conclusion is reached that the temperature below the 100 km. level must be considerably higher; the scarcity of meteors disappearing at heights of about 55 km. was the first indication of a rapid rise of temperature in this region. Not only the sound phenomena discussed by Dr. Whipple, but also recent optical observations by F. Link on the variation of the zenithal brightness of the sky during the twilight hours are in excellent agreement with the meteor evidence.

Dr. E. V. Appleton (London) gave an account of the structure of the higher atmosphere as elucidated by the radio-physicists. In the radio exploration of the ionosphere two quantities are measured, namely, the height of reflection and the coefficient of reflection. Both quantities yield information of interest.

From the measurement of the heights of reflection on different frequencies, the electronic structure of the various layers can be deduced, from which it is possible to estimate the values of the 'scale height' H at the appropriate levels. A thick layer is produced by the absorption of solar radiation if the atmospheric density varies slowly with height (large H) and vice versa. There is evidently some factor operative which brings about an increase of H between 100 km. and 300 km., for at the level of the E Layer (100 km.) the scale height is found to be 11·0–11·5 km., whereas at the level of the F Layer (300 km.) the scale height is 40–50 km. An increase of scale height can only be the result of an increased temperature or of the presence of a light atmospheric constituent such as helium. The former is considered by Dr. Appleton to be the more likely; the calculated temperatures are 385° K. for the E Layer and about 1400° K. for the F Layer. Measurements of the reflection coefficient of radio wave yield approximate values of the air density at the level of reflection. These indicate molecular densities of 10^{13} and 10^{10} at the levels of Layers E and F respectively.

From the evidence from sound described by Dr. Whipple, it seems necessary to assume temperatures of more than 330° K. at 50–60 km. height. Since radio observations indicate a temperature rising from a lower degree than that at about 90 km., there should be a temperature fall between 60 km. and 90 km. Recent radio experiments seem to show directly that at a height of 75 km. there is a temperature of only 200° K. The technique applied in the study of this region (the use of wireless waves of about 18 km. length) was only touched upon by Dr. Appleton, but described in greater detail by Mr. J. A. Ratcliffe (Cambridge) in the course of the general discussion which followed the introductory addresses.

Another important contribution to the general discussion was made by Dr. D. F. Martyn from Australia. He communicated the results of 19 months' continuous observations of the maximum ionization densities of the F_2 region, carried out at half-hourly intervals in two stations in Australia, which seem to prove a connexion between this ionization and the meteorological conditions at the ground. This relationship can, in Dr. Martyn's opinion, scarcely be explained by changes in the temperature of the upper atmosphere. The most likely explanation appears to be that there exist large-scale movements of air in the high atmosphere in parallel with the main air mass movements at low levels—that, for example, a large influx of tropical air at low levels is accompanied by an influx of air of special characteristics (probably high humidity and/or low ozone content) at the very high levels up to 250 km.

For those attending the meeting, it must have been satisfactory to learn that the items of information obtained by such widely different methods about the conditions in the upper atmosphere can be put together into a consistent picture. There are still many gaps to fill, due not only to the scarcity of the material yet collected but also to the obvious limitations of the methods; while the sampling and direct measuring is confined to the heights which sounding balloons can attain, the optical, acoustical and electrical methods can only reveal the chemical and physical state of certain heights in which peculiar phenomena occur. It is, on the other hand, very gratifying to see that where overlapping occurs, the results obtained by entirely independent methods corroborate each other or, at least, are not contradictory. One can, therefore, attempt to summarize the main points of our present-day knowledge of the composition, temperature and density of the upper atmosphere, as reflected in this discussion.

The atmospheric gases (with the exception of water vapour, ozone and radon) are present in constant proportion up to the height of approximately 20 km. Between 20 km. and 30 km. the helium content increases, the oxygen content decreases by a few per cent, but there is no indication that this separation process of light and heavy gases becomes more marked with height: the total atmosphere is essentially a nitrogen-oxygen mixture. Under the influence of sunlight these two gases are ionized, and oxygen dissociated, so that the higher atmosphere consists mainly of nitrogen molecules and oxygen atoms, while lower down there is also molecular oxygen and ozone. Ozone has its highest concentration per volume at about 25 km.

The temperature decreases fairly regularly from the ground level upwards, assumes (in the latitude of

Great Britain) at 10–11 km. height a value of about 220° K. which remains constant to at least 30 km. From a few kilometres below 40 km. upwards, the temperature increases until it reaches at 50–60 km. more than 330° K., whereupon it falls again, to a lower level than that of the stratosphere; the minimum, of about 200° K., is reached between 70 km. and 90 km. From here onwards the temperature rises again; at 100 km. it is about 380° K., at 300 km. it is in the neighbourhood of 1400° K., and may increase still further with height.

Thanks to the rise in temperature from 40 km., and again from about 90 km. onwards, the density of the atmosphere is much greater above these heights than would be caused by gravity distribution if the temperature of the stratosphere remained constant. At 100 km. it is of the order of 10^{13} molecules/c.c., at 300 km. it is still 10^{10} molecules/c.c. F. A. PANETH.

Institution of Gas Engineers

THE seventy-sixth annual general meeting of the Institution of Gas Engineers, held in London during June 6–9, was noteworthy as the centenary of the death of William Murdoch, the versatile Scot, who is acclaimed as the father of the British gas industry. Mr. Robert Robertson, engineer and manager of the Bristol Gas Co., presided.

In a symposium on the present and future prospects of the town's gas industry, eleven Dominion and Overseas engineers, describing the conditions in their own countries, revealed that the idea of distilling coal for lighting gas arose in several places, but it was recognized that no one deserves more credit than Murdoch for establishing the practicability of coal gas manufacture.

These contributions showed that in every country the rise of newer industries such as those of oil and electrical supply has exerted an influence on the use of gas in certain directions, accentuated by the greater efficiency of appliances. Nevertheless, the merits of a clean gaseous fuel has sufficed not merely to maintain but also to increase the consumption of gas even in those countries where all coal must be imported while hydro-electric power is abundant. The president of the Swiss Gas Association, for example, says that in spite of the great financial efforts of the electrical industry, the Swiss housewife appreciates the value of the gas flame with its instantaneous heat, its great power and quality of being visibly regulated within wide limits.

In Norway the need for coke has a dominating influence, and the gas industry can supply only 8 per cent of the country's needs. Large losses, apparently, have been incurred there by too optimistic investments of public funds in hydro-electric works in the erroneous belief that the power so generated might replace gaseous fuel.

The president's address—a review of the development of the gas industry—contained a notable announcement of a new departure in its policy of organized research. In this, the industry has been a pioneer, for thirty years ago—long before the days of research associations—the Institution began the practice of supporting co-operative research. During this time it has furthered a programme of research done at the University of Leeds, and the president's address referred to nearly fifty reports issued from this source. In the meantime, many gas undertakings, contractors and associations concerned with by-products have produced an increasing volume of experimental work. It is estimated that about a quarter of a million pounds in the aggregate is spent annually in development work. Nevertheless, such is the state of flux in the utilization of fuel that a widening of the organization of research is projected.

Until recently, investigation could be confined to established practice of making and using gas, but to-day the industry is seeking to widen the range of coals suitable for gas making and to convert these into solid, liquid and gaseous fuel in any desired proportion—even to complete gasification by the use of high-pressure technique. It is now proposed to establish a Gas Research Board supported by the subscriptions of gas undertakings and manufacturers of plant and appliances. The first president will be Sir David Milne Watson, and a director of research will be appointed. The Board will be constituted so as to qualify for Government grants if and when this is thought desirable. It is proposed to use the facilities available in existing institutions—at least in the immediate future. The functions of the Board will be: (1) the collection and dissemination of information concerning research of interest to the gas industry, (2) the provision of contact and co-ordination between research workers similarly engaged, (3) the observation and reporting of work in progress and (4) planning and arranging of future work.

Dr. E. F. Armstrong gave a lecture in memory of Murdoch tracing the growth of the gas industry and speculating on its prospects.

Non-technical readers would be interested in a paper by L. W. Andrew and A. Barrow on comfort heating by gas. To-day gas is being increasingly sold on two-part tariffs which encourage the freer use for major heating and raise the question as to the extent to which it can replace solid fuel for continuous heating. The advantages of cleanliness, flexibility and reduction of labour have long been recognized, particularly for intermittent heating. For central heating, solid fuels, especially coke, have appeared to show an unassailable advantage, but coal gas is increasingly entering this field when cleanliness, high rent and automatic control offer sufficient inducement. 'Central heat' is normally conveyed by means of hot water, but 'central' heat can more cheaply and simply be conveyed in a potential form as coal gas, and the problem to-day is to devise means for converting this into effective and acceptable sensible heat.

The paper distinguishes between 'warmth' and 'comfort'. For comfort, it would appear to be desirable to have air at 50–60° F. in movement without perceptible draught, supplemented by radiant heat received on the front of the body from an incandescent source. Shorter infra-red rays of length below 3μ capable of penetrating the skin, according to L. Hill, are of particular value. In addition, tradition in Great Britain requires an open fire with the character associated with the open coal fire. The authors believe that these requirements can be met by

combining 'background' heating by flueless appliances with suitable gas fires. For continuous domestic heating they think the radiating gas fire will take a new form, whether in some measure resembling the coal fires of the past—as it may in the near future—or taking a more revolutionary form. In support of this view they exhibited a gas fire of new design such that any ordinary person walking past would take it for a coal fire of conventional type. Instead of the formal geometrical radiants, it exhibited a face of black mass enclosing glowing cavities surmounted by a play of real flames. There must be many to-day who would find it worth while to pay something extra for the merits of a coal fire without its demerits.

For commercial buildings new designs of overhead radiating panels—both high and low temperature radiators—are now available. In factories, the 'unit heater' which provides a stream of warm air directionally propelled offers many advantages. All these offer considerable advantages over central heating by circulation of hot water, and the paper suggests that great developments may be expected in gas heating.

H. J. HODSMAN.

Structure of Trilobites

By Dr. W. T. Calman, C.B., F.R.S.

THE trilobites are generally recognized as occupying a key position in relation to the phylogeny of arthropods, and until we have some certainty as to their structure and relationships it is not possible to speculate profitably about the mutual affinities of insects, crustaceans and arachnids. In the course of the last sixty years, a great deal of information regarding their appendages has been obtained, for the most part by American palæontologists; but the results of different investigators have not been easy to reconcile and very divergent conclusions have been drawn regarding the systematic position of the group.

Dr. C. D. Walcott, who was the first to obtain definite information about the appendages, worked chiefly on the Ordovician genus *Ceraurus*, which he studied in thin sections. Dr. C. E. Beecher (whose final memoir was completed after his death by his pupil, P. E. Raymond) studied abundant material of *Triarthrus*, from the same epoch, as exposed in surface view by splitting the rock. The results of these two workers seemed to reveal an extraordinary difference of structure in the limbs of the two genera. The legs of *Ceraurus* were provided by Walcott with a pair of corkscrew-shaped gills attached near the base, while those of *Triarthrus*, according to Beecher, were simply biramous, with the outer branch segmented and fringed on one side with flattened filaments. Taking up the subject again towards the end of his life, Walcott maintained that the spiral 'gills' really existed but now allotted only one of them to each limb and provided it with a row of flattened filaments like those described by Beecher in *Triarthrus*. In a review of Walcott's paper[1], I pointed out that the row of filaments, attached to the successive turns of an open helical spiral, would not remain in one plane as they are seen to do in the fossils, unless the spiral were rigid to an improbable degree.

Dr. Leif Størmer, in an important memoir[2], discusses the whole subject in the light of a re-examination of Walcott's and Beecher's preparations. He has also applied Sollas's method of serial grinding and reconstruction to *Ceraurus*, and has obtained some very interesting and convincing results. In the first place, the fundamental differences which Walcott supposed to exist between the appendages of *Ceraurus* and *Triarthrus* have disappeared. The spiral structures are proved to depend on misinterpretation of the sections. In *Ceraurus*, as in *Triarthrus*, the appendages are simply biramous, with an outer branch consisting of a segmented stem fringed on one side with a single row of flattened rod-like or filamentous structures which may, or may not, have served as gills. In view of the poor state of preservation of the appendages in *Ceraurus* and the obscurity of the traces that they have left in the rock, it is not surprising that many details of their structure must remain uncertain, but Størmer appears to be justified in claiming that all the trilobites so far studied have appendages built on the same plan. Beyond this, however, his far-reaching deductions can only be treated with much reserve.

Impressed with his discovery in *Ceraurus* (and, very doubtfully, in other genera) of a 'precoxal' segment to which the outer branch of the limb is attached, he designates this outer branch 'pre-epipodite' and deduces from this that the trilobites have no close relationship with the crustacea but are, on the other hand, intimately associated with the eurypterid-arachnid group. To do this, he has to minimize the importance of those characters in which the trilobites diverge from the Arachnida and approach the Crustacea. To anyone with a sense of morphological values, however, the flagelliform preoral antennules, the five pairs of biramous gnathobase-bearing head appendages following them, and the furcal filaments (of *Neolenus*) far outweigh the fact that the peduncle of the biramous limbs is unsegmented, as it is, by the way, in not a few Crustacea.

The resemblances between trilobites and primitive arachnids have been often pointed out and are generally admitted, but Størmer does not strengthen his case by taking seriously Schultze's far-fetched comparisons between trilobites and ticks (Ixodidæ). To reason from fortuitous and isolated coincidences of structure is to play into the hands of those who are so ready nowadays to proclaim the bankruptcy of morphology and phylogeny. Anyone who is tempted by such slapdash methods may be recommended to consider the numerous and striking resemblances between trilobites and isopod Crustacea, and then to study carefully the evidence for the derivation of the Isopoda from primitive Mysidacea, which have scarcely anything in common with trilobites except that they are arthropods.

[1] *Geol. Mag.*, **59**, 553 (1922).

[2] "Studies on Trilobite Morphology. Part I. The Thoracic Appendages and their Phylogenetic Significance". (*Norsk Geol. Tidsskr.*, **19**, 143–723, 12 pls., text-figs.)

University Events

CAMBRIDGE.—Dr. L. E. R. Picken, of Trinity College, has been re-elected to the Balfour studentship, for research on the molecular morphology of living cells.

Grants from the Balfour Fund have been made to the following: D. A. Webb, of Trinity College, £20, for expenses whilst working at the Millport Marine Station; to D. A. Webb, of Trinity College, £40, for expenses whilst working at Prof. Krogh's Laboratory in Copenhagen; Dr. C. H. Waddington, £25, towards the expenses of visiting the Marine Laboratory, Woods Hole; M. G. M. Pryor, of Trinity College, a sum not exceeding £40, for expenses whilst working under Prof. Kühn in Berlin; Dr. V. J. Chapman, £25, towards the cost of an expedition to the West Indies; Dr. R. J. Pumphrey, £20, for expenses whilst doing research at the Plymouth Marine Station.

The Frank Smart studentship in botany will be vacant on October 1. Any graduate of the University is eligible for the studentship provided that not more than eighteen complete terms have elapsed after his first term of residence. Women also are eligible. The successful candidate must devote himself to research in botany under the direction of the Professor of Botany. A student may be appointed for one year or for two years. The value of the studentship is £210 a year. A candidate must send his name, with a statement of the course of research which he proposes to undertake, and such evidence of his qualifications as he thinks fit, to Prof. F. T. Brooks, at the Botany School, on or before September 30.

OXFORD.—At Encaenia on June 21, the following among others received honorary degrees: *D.Sc.*, Sir Edward Mellanby; *D.C.L.*, the Marquess of Lothian, Sir Maurice Gwyer, Admiral Sir Herbert Richmond and the Hon. Vincent Massey.

Dr. Robert Gunther has resigned his appointment as honorary University reader in the history of science at Oxford. He will remain in charge of the Museum of the History of Science. Work on the Oxford dictionaries, hitherto carried out in the lecture room of the old Ashmolean Museum, is being transferred to the new Bodleian extension.

Dr. E. G. T. Liddell, Trinity College, and Mr. D. L. Hammick, Oriel College, have been elected members of the Hebdomadal Council.

Prof. R. S. Troup is resigning the professorship of forestry on July 31, 1940.

E. F. Caldin, Queen's College, has been elected to a junior research fellowship (in chemistry) at Queen's College. Dr. A. H. Cooke, Christ Church, has been elected to a lectureship in physics (the equivalent of a research fellowship) at Christ Church. Miss A. Pellew, St. Hugh's College, has been elected to the Moberly senior scholarship (in engineering).

The following new appointments have been made: E. B. Ford, Wadham College, reader in genetics; C. F. W. R. Gullick, lecturer on economic geography; Dr. R. A. Hull, St. John's College, demonstrator and lecturer in physics; R. N. Chrystal, demonstrator and lecturer in entomology; A. C. Hoyle, Pembroke College, and Dr. N. V. Polunin, Christ Church, demonstrators and lecturers in botany.

SHEFFIELD.—Prof. R. P. Linstead has resigned from the Firth chair of chemistry, on his appointment to the chair of organic chemistry in Harvard University.

Science News a Century Ago

Giraffe Born at Zoological Gardens

ON June 25, 1839, Prof. Richard Owen read to the Zoological Society "Some Notes on the Birth of a Male Giraffe at the Zoological Gardens". The animal was born on June 19. The period of gestation, said Owen, had been, as nearly as possible, ascertained to be fourteen months, eighteen days, or fifteen lunar months. The young animal, when born, was perfectly motionless, and apparently dead, or strangulated, its lips and nose being tinged with blood; but after gentle friction had been used for a short time, breathing and motion quickly followed. The mother was in no way depressed or debilitated. The animal came into the world like other ruminants, with the eyes open, but the hoofs were disproportionately large, and very soft and white at their expanded extremities; the skin was marked as distinctly as in the adult; the horns were represented by stiff and long black hairs, and the mane was well developed.

Allan Cunningham (1791-1839)

ALLAN CUNNINGHAM, an eminent botanist and traveller, was born at Wimbledon, Surrey, on July 13, 1791, his father being a gardener. Having become connected with the Gardens at Kew, he became known to Sir Joseph Banks and on September 4, 1814, he was appointed botanical collector in the southern hemisphere for the royal gardens. Sailing from Plymouth in October 1814, he did not return to England until July 1831. In turn he visited Rio de Janeiro, and parts of Brazil, New South Wales, New Holland, Van Dieman's Land, New Zealand and Norfolk Islands. Though after his return home he was in somewhat indifferent health, he was offered the post of colonial botanist in New South Wales, but declined it in favour of his brother Richard, who, however, was killed by natives in April 1835. Cunningham now accepted the office and proceeded to Sydney, but his strength failed him and he died on June 27, 1839, at the age of forty-eight years.

Becquerel's Electrical Experiments

"M. BECQUEREL," said the *Athenæum* of June 29, 1839, "has read the first part of a memoir before the French Academy of Sciences, containing an account of his new experiments on the electric forces of contact. These led him to conclusions concerning the causes of certain effects which differ from those of Davy, who ascribed them to mere contact. M. Becquerel refers them to friction and hopes to prove it by the following experiments. First, two conducting plates made of platina were adapted to an excellent electroscope; one of them was touched with a very dry piece of chalk, and the other with the finger; on separating the plates, it was found that no electric effect had been produced. Secondly, a layer of calcined lime, highly dried, was spread on a piece of wood, equally dry; upon this was carefully placed, so as not to allow of friction, a plate of copper, fixed to a handle; it was then put in contact with one of the plates of the condensator, while the other was touched with the finger. After repeating this several times, no electric discharge was obtained, but if the copper disc were placed on the lime with friction, the condensator was charged after touching a few times, and the greater the friction the stronger the charge."

Societies and Academies

Paris

Academy of Sciences (*C.R.*, **208**, 1445–1540, May 8, 1939).

J. CHAZY: Value at infinity of the solutions of certain differential equations.

C. MAUGUIN and J. LAVAL: Fourier lattice and thermal agitation.

H. COLIN and J. AUGIER: A novel glucide in the Florideæ of the genus *Polysiphonia*—the α-*d*-mannoside of sodium *l*-glycerate.

G. BERTRAND and L. SILBERSTEIN: Boron content of soil. Although present in most soils, the quantity is so small (10–30 mgm. per kgm. of fine soil), that its estimation is only possible with specially purified reagents.

F. GRANDJEAN: The 'probability' of the existence of organs and of characters.

H. VINCENT: New experimental researches on hepatic 'dysphylaxy' in coli bacillary infection.

G. GIRAUD: A type of problem relative to elliptic equations with two independent variables.

J. DE LAPPARENT and R. HOCART: Leverrierite of the lateritic formations of French East Africa.

M. KRASNER: Fermat's theorem.

E. J. GUMBEL: Duration of decline as a measure of independence.

S. CHERUBINO: Kronecker's index and the algebraic correspondences between curves.

L. BERS: Limiting values of analytical functions of two complex variables in domains possessing an observable bounding surface.

H. GUILLEMET: Influence of the periodic transversal movement of the leading edge of the wing of an aeroplane on the reaction exerted by the fluid.

R. LEDUC and J. VILLEY: The permanent limiting discharge flow of a current of air around a source.

J. DUFAY and J. GAUZIT: Application of interference to the study of stellar spectra.

J. MARIANI: Geometric interpretation of spin.

G. BIDEN: Integration of M. De Donder's equation.

D. DERVICHIAN and M. JOLY: Transformations of higher order in mono-molecular layers.

L. AGOSTINI: An apparatus for measurement of the specific heats of gases working on very small supplies of gas.

MME. M. MOREAU-HANOT: Transport of electric charges by droplets.

A. MARSAT: Some consequences of the diffusion of light by corpuscles suspended in the atmosphere.

MLLE. S. VEIL: Liesegang periodicities by attack, in gelatin, of coarse solid suspensions.

A. PORTEVIN: Specific character of structures formed in the fractional decomposition of austenites with cooling as a function of the temperature of the isothermal stage.

M. MOUSSERON and R. GRANGER: Some optically active stereoisomeric alicyclic acids, alcohols and aldehydes.

G. DARZENS: Action of aqueous solutions of ammonia on halogen derivatives: new method of preparation of aliphatic diamines.

R. VIEILLEFOSSE: Mechanism of formation of thioacetic dichloride: polymolecular anhydride-chlorides of thioacetic acids.

F. SALMON-LEGAGNEUR: α-α-Diphenylsuccinic acid.

P. FLEURY and MLLE. R. BOISSON: Action of periodic acid on acetone and on diethylacetone.

J. LAVAL: Diffusion of X-rays outside some directions of selective reflection by crystals [possibly due to thermal agitation].

M. BREISTROFFER: Lower Cenomanian of the *fosse vocontienne* (Hautes-Alpes et Drôme).

H. BESAIRIE: Magnetic results for 1939 from the coast of French Somaliland.

MME. A. VASSY and E. VASSY: Influence of solar radiation on the mean temperature of the atmospheric ozone.

C. COMBIER: Some new problems raised by the photography of the shadow of the earth.

P. QUENEY: A counter of large ions giving directly the spectrum of mobilities.

J. DEBRACH: Variations of the effective nocturnal radiation, in the course of clear nights.

M. SIMONET and P. DANSEREAU: Meiosis in two hybrids of *Cistus*, *C.* × *hybridus* Pourr. and *C.* × *rodiei* Verg. var. *antipolitensis* Dans.

MLLE. M.-L. VERRIER: The theory of Exner and the comparative histophysiology of compound eyes.

A. PEZARD: Numeration of the Purkinje cells in the cerebellum of various birds.

E. WOLFF: Action of diethylstilbœstrol on the genital organs of the chick embryo. It has a powerful ferminizing effect, analogous to that of œstrone.

N. PERAKIS: Magnetochemical analysis of the egg of the urchin (*Echinus melo*).

F. OBATON: Influence of colchicine on the development of *Photobacterium phosphoreum*. It increases the luminosity of cultures, due to acceleration of development.

G. JEANNENEY, C. WANGERMEZ and G. RINGENBACH: Electric charge of the blood and transfusion shock. Post-transfusion shock depends on the sign of the electric charge of the donor's blood.

Amsterdam

Royal Netherlands Academy (*Proc.*, **42**, No. 3; 1939).

J. BÖESEKEN: Steric conditions in the cyclic acetone-acetals of the *ortho*-diphenols.

R. WEITZENBÖCK: Projective invariants of four and five straight lines in the four-dimensional space R_4.

MISS W. A. LUB: Isotopic constitution of nickel and chromium. The existence of the ^{61}Ni isotope with an abundance of 0·1 per cent is confirmed and that of the ^{50}Cr isotope rendered probable.

P. G. MOLENAAR: A differential invariant of the second order of the binary cubic differential form.

W. BEIJERINCK: Diatoms from the brooks of the province of Drente (Holland).

H. G. BUNGENBERG DE YONG and O. BANK: Behaviour of microscopic bodies consisting of biocolloid systems and suspended in an aqueous medium. (4) Vacuolation phenomena of complex coacervate drops at a constant temperature. Formation of foam structures and of thin-walled drops with a large central vacuole. (5) Gelatinized hollow spheres. Temporary invagination to gastrula-like bodies by mechanical or osmotic removal of water from the central cavity.

Cracow

Polish Academy of Sciences (April 3, 1939).

J. SAMSONOWICZ: The Carboniferous in the basin of the Upper Bug. Six borings, over an area of 1,300 sq. km., have proved the existence of the Carboniferous below the Cretaceous, which increases in thickness from 111 m. in the east to 287 m. in the west.

MLLE. J. REJMENT: Hepatics of the Silesian Beskid.

MLLE. I. MIKULSKA: Material for the study of the Araneids as a constituent element of the biocœnosis in some forests of the Silesian Carpathians.

Forests of the *Fageto-abietetum* type are richest in number of species, while small numbers are found in beech plantations.

J. ST. MIKUSKI: Ephemeropteran fauna of the torrents giving rise to the Vistula. The two streams show hydrographic and faunistic differences; judged by the Ephemeroptera found, they are middle altitude rather than high mountain streams.

Moscow

Academy of Sciences (*C.R.*, **22**, No. 1; 1939).

S. BERNSTEIN: Determination of a series of given functions from the values of the extremes and of the successive remainders.

G. ŠILOV: Ideals and sub-rings of the ring of continuous functions.

I. GELFAND and A. KOLMOGOROFF: Rings of continuous functions on topological spaces.

W. S. IGNATOVSKIJ: Contributions to the grid theory (2, 3).

I. L. ZELMANOV: A new method of helium liquefaction by means of the Joule-Thomson effect.

N. BUYNOV, M. JURAVLEVA, A. KOMAR and G. ČUFAROV: Iron crystal orientation in magnetite reduced by hydrogen.

V. L. GRANOVSKY: The time of the restoration of controllability in a gas discharge.

G. B. RAWITSCH: The dependence of viscosity of fatty acids with high molecular weight on the temperature and the degree of their saturation.

V. KASSATOCHKIN: Electronic defraction in the surface layers of metal alloys.

F. P. SAVARENSKY and N. V. KOLOMENSKY: Friction and cohesion of coherent rocks.

G. G. LAEMMLEIN: The orientation of quartz crystals in veins of the Alpine type in the subarctic Urals.

A. A. YATSENKO-KHMÉLEVSKY: An anatomical study of the propagation of fungus hyphæ in a dead forest of *Picea orientalis* Carr.

A. SERGEYEV: The body temperatures of reptiles in natural surroundings.

A. BELOGUROV: Variation in structure of the alimentary canal in sturgeons, in connexion with nutrition.

C.R., **22**, No. 2; 1939.

I. M. VINOGRADOW: A new improvement of the method of estimating trigonometrical sums with primes.

B. GNEDENKO: The limiting theorems for sums of independent variables.

S. V. KRAVKOV: Critical frequency of flicker and indirect stimuli. Some correlations of different receptors in our colour vision.

N. T. FEDOROV: Some regularities underlying the effect of indirect stimuli (*Nebenreiz*) upon the discrimination sensitivity of the eye.

N. T. FEDOROV and V. I. FEDOROVA: The number of light-sensitive substances in the retina.

V. I. NIKOLAEV and A. G. KOGAN: A new method of production of potassium nitrate by exchange decomposition of potassium chloride with nitric acid at low nitric acid concentrations and temperature.

A. A. TRAPEZNIKOV: Mechanical properties of 'two-dimensional' caoutchouc. The micellar structure of caoutchouc.

D. MCCONNEL: Isomorphic substitutions in apatite.

N. V. BELOV: Some isomorphic substitutions in the apatite group.

I. A. KOROBKOV: The age of the Sakaraul horizon.

Forthcoming Events

[*Meeting marked with an asterisk is open to the public.*]

Monday, June 26

ROYAL GEOGRAPHICAL SOCIETY, at 3.—Annual General Meeting.

Tuesday, June 27

BIRKBECK COLLEGE, at 6.—Sir Percy Nunn: "Education and Reality" (Haldane Memorial Lecture).*

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.45.—Annual Meeting. H. J. Braunholtz: "Archæology in Peru: Recent Progress" (Presidential Address).

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

LECTURER IN CHEMISTRY AND PHYSICS in the Borough Road College, Isleworth—The Principal (June 28).

LECTURER IN MECHANICAL AND CIVIL ENGINEERING in the Sunderland Technical College—The Director of Education, Education Offices, 15, John Street, Sunderland (June 28).

ENGINEERING ASSISTANT (Junior Grade) to the Conservators of the River Thames—The Secretary, Thames Conservancy, 2-3 Norfolk Street, Strand, W.C.2 (June 29).

SCIENTIFIC OFFICERS (Physics, Chemistry and Mechanical Science), JUNIOR SCIENTIFIC OFFICERS (mathematics and physics), ASSISTANTS (grade II, mathematics, physics and chemistry), ASSISTANTS (grade III, mathematics and arc welding) in the Research Department, Royal Arsenal, Woolwich, S.E.18—The Under-Secretary of State (C.5), War Office, London, S.W.1 (June 30. Quote Appts. 147B).

LECTURER IN PRODUCTION ENGINEERING in the County Technical College, Wednesbury—The Director of Education, County Education Offices, Stafford (July 3).

ASSISTANT LECTURER IN MATHEMATICS in University College, London—The Secretary (July 3).

PRINCIPAL AGRICULTURAL OFFICER in the Federated Shan States, Burma—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (August 14. Quote 5/153B).

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1840 (2204, 2598): The Lateral Stability of Highly Loaded Aeroplanes. By L. W. Bryant and Dr. A. G. Pugsley. Pp. 11. 2*s.* net. No. 1845 (3505): The Protection of Magnesium Alloy Sheet against Corrosion by the use of Enamels containing High Purity Chromates. By L. F. Le Brocq. Pp. 24. 3*s.* 6*d.* net. (London: H.M. Stationery Office.) [16

Scientific Proceedings of the Royal Dublin Society. Vol. 22 (N.S.), No. 10: An Apparent Connection between the Presence of Colloids and the Osmotic Pressures of Conifer Leaves. By O. Roberts and S. A. Styles. Pp. 119–126. 6*d.* Vol. 22 (N.S.), No. 11: Embryogeny in *Sarcopthaes* and its relation to other Podocarpæ. By J. Doyle and W. J. Looby. Pp. 127–148. 2*s.* Vol. 22 (N.S.), No. 12: Studies in Peat, Part 5: Extraction of Peat with Azeotrope-like Petroleum mixed Solvents. By J. Reilly, D. F. Kelly and J. Duffy. Pp. 149–156. 6*d.* Vol. 22 (N.S.), No. 13: Studies on the Ultimate Composition of Biological Material. Part 3: Glandular Tissues. By Robert Press and William Robert Fearon. Pp. 157–160. 6*d.* Vol. 22 (N.S.), No. 14: Report of the Irish Radium Committee for the Year 1938, including Reports from Oswald J. Murphy and Oliver Chance. Pp. 161–174. 1*s.* (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [26

Other Countries

Division of Fish and Game of California: Bureau of Marine Fisheries. Fish Bulletin No. 53: Measures of Abundance of the Sardine, *Sardinops caerulea*, in California Waters. By Frances N. Clark. Pp. 45. (Terminal Island, Calif.: California State Fisheries Laboratory.) [315

Egyptian University: Faculty of Science. Report for the Session 1934–1935. Pp. iii+122. Report for the Session 1935–1936. Pp. iii+94. Report for the Session 1936–1937. Pp. 112. Report for the Session 1937–1938. Pp. 100. (Cairo: Government Press.) [16

Ceylon. Part 4: Education, Science and Art (G.). Administration Report of the Marine Biologist for the Year 1938. By A. H. Malpas. Pp. G11. (Colombo: Government Record Office.) 10 cents. [16

Publications of the Lick Observatory. Vol. 14, Part 3: The Spectrum of Nova Aquilæ (1918). By Arthur B. Wyse. Pp. 89–216+plates 7–10. (Mt. Hamilton, Calif.: Lick Observatory.) [26